PROJECT MANUAL
Volume 01: Divisions 00 through 12

Cumru Fire Department

Project No: 18-036
1775 Welsh Road
Mohnton, Pennsylvania 19540

PREPARED FOR:

CUMRU FIRE DEPARTMENT
1775 Welsh Road
Mohnton, Pennsylvania 19540

BID SET
November 30, 2023

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DOCUMENT 000115 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

A. Drawings: Contract Drawings shall consist of the following separately bound drawing sets or separate drawings:

1. General/Code, Civil, Architectural, Structural, Mechanical, Plumbing, Electrical, Electrical CAD Alerting System:

a. Drawings shall include, but not be limited to, the Contract Drawings and other drawings listed within the Drawing Index located on sheet G000 "COVER SHEET" of the separately bound drawing set titled CUMRU FIRE DEPARTMENT dated November 30, 2023, as modified by subsequent Addenda and Contract modifications.

END OF DOCUMENT 000115

DOCUMENT 001116 - INVITATION TO BID

1.1 PROJECT INFORMATION

A. Notice to Bidders: Qualified bidders are invited to submit bids for Project as described in this Document according to the Instructions to Bidders.

B. Project Identification: Cumru Fire Department.

1. Project Location: 1775 Welsh Road, Mohnton PA 19540.

C. Owner: Cumru Township.

1. Owner's Representative: Jeanne Johnson, 1775 Welsh Road, Mohnton PA 19540 .

D. Architect: Manns Woodward Studios Inc.

E. Project Description: Project consists of, generally, the construction of a new single story, with mezzanine, fire station approximately 22,908 gross square feet.

F. Construction Contract: Bids will be received for the following Work:

1. Multiple Contract Project consisting of the following prime contracts:
   a. General Building Construction; 1A
   b. Mechanical Construction; 15A.
   c. Plumbing Construction; 15B
   d. Electrical Construction; 16A

1.2 BID SUBMITTAL AND OPENING

A. Owner will receive digitally submitted bids until the bid time and date via Pennbid. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by the Owner, as submitted through Pennbid as follows:

1. Bid Date: January 29th , 2024
2. Bid Time: 10:00 am EST
3. Location: Pennbid website; www.pennbid.net

B. Bids shall be automatically tabulated and available through the Pennbid website.

1.3 BID SECURITY

A. Bid security shall be submitted with each bid in the amount of 10 percent of the bid amount. No bids may be withdrawn for a period of 90 days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 MANDATORY PREBID MEETING

A. A mandatory pre-bid meeting will be held on site at the following date and time:
   1. Date: December 14th 2023
   2. Time: 1:00 pm EST
   3. Location: Ground floor lobby, Cumru Township Building, 1775 Welsh Road, Mohnton PA 19540.

1.5 DOCUMENTS

A. Online Procurement and Contracting Documents: Obtain access after November 30, 2023 by registering on the Pennbid website; www.pennbid.net. Online access will be provided to all registered bidders and suppliers.

1.6 TIME OF COMPLETION AND LIQUIDATED DAMAGES

A. Bidders shall begin the Work on receipt of written Notice to Proceed, as provided by the Cumru Township and shall complete the Work within the Contract Time. Work is subject to liquidated damages.

   1. Contract Time: The Bidder agrees to begin work within ten (10) calendar days of the date designated in the Notice to Proceed, and to substantially complete the work ready for Owner use (substantial completion) within 420 calendar days from the date designated in the Notice to Proceed and to complete the entire Contract ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES, within 450 calendar days from the date designated in the Notice to Proceed.
   2. Liquidated Damages: Liquidated damages shall be $1000.00 per day, for every day that exceeds the contract time duration or previously Owner approved time extensions.

1.7 BIDDER'S QUALIFICATIONS

A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. A Performance Bond, a separate Labor and Material Payment Bond, a Maintenance Bond, and Insurance in a form acceptable to the Owner will be required of the successful Bidder.

B. Bidders and Sub-Bidders (subcontractors to Prime Contractors) shall have and shall be able to present the following information and qualifications to submit a Bid.

1. All bidders (prime contractors) and sub-bidders (subcontractors to Prime Contractors) shall possess the following minimum qualifications:

   a. Project Experience: Contractor shall have and be able to present experience in performing construction activities similar (similar approximate gross building area, construction type, project type (fire station, EMS station, municipal vehicle maintenance/repair facility), and similar MEPF systems) to those activities identified by the Bidding Documents of this project. Contractor shall be able to present a minimum of 3 projects completed within the previous 10 years (Substantial Completion occurring in of after November 2013.)

   b. Projects presented, shall include contact information for representatives for the following:

      1) Owner Representative

      2) Architect Representative

      3) MEP Engineering Representative

      4) Civil Engineering Representative

      5) Bidder's project manager and superintendent/foreman

   c. Each project presented shall include a description of work, total project area (gross square feet of all stories in which work was performed), Bidders Bid Cost, and Bidders Final Cost.

   d. Each project presented shall include a statement indicating whether any form of dispute resolution occurred or is in process on the project between the Bidder and any other party involved within the project, identification of initiating party (Bidder, Owner, Subcontractor, etc.)

   e. Each project presented shall include photographs of work performed both in-process (where available) and work completed.

C. Prime Contractors to utilize AIA A305-2020 to complete the requirements of this section and to submit as part of the completed bid package. Contractors shall be required to purchase and provide all AIA documents required for submission of Bid.

END OF DOCUMENT 001116

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

A. Prime Contractors to utilize AIA forms outlined in this section. Contractors shall be required to purchase and provide all AIA documents outlined within this section.

B. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732

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

1. A draft copy of AIA Document A701-2018, "Instructions to Bidders," is bound in this Project Manual.
   a. Contractor(s) shall make modifications to the AIA Document A701-2018 – Instructions to Bidders per modifications indicated in the Owner provided draft copy, per Section 002113a – "–AIA A701-2018 – Instructions to Bidders - DRAFT."

D. Reference Section 00 4400 – "Owners Documents – Instructions to Bidders" for supplemental information in addition to this Section.

END OF DOCUMENT 002113

DRAFT

AIA® Document A701® – 2018

Instructions to Bidders

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

Cumru Township Fire Department»
Cumru Township, Pennsylvania
Berks County

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

Cumru Township
1775 Welsh Road
Mohnton, Pennsylvania
Telephone Number: (484) 256-7290

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

Manns Woodward Studios, Subchapter S Corporation»
10839 Philadelphia Road
White Marsh, Maryland 21162
Telephone Number: 410-344-1460
Fax Number: 443-403-2460

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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.
- **.7** Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted Bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner. Bidder shall be responsible for obtaining building permits.
- **.8** Bidder is properly licensed according to the laws and regulations of the state and local authorities having jurisdiction and meets qualifications indicated in the Proposed Contract Documents.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

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

Bidders shall register on the Pennbid procurement website; www.pennbid.net.
Registered Bidders shall download complete sets of bidding documents.

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

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

§ 3.1.4 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 via the "Questions" feature within the procurement website; Pennbid at www.pennbid.net.

§ 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 Only pre-bid/procurement substitutions shall be considered. Any substitution received after the acceptance of the Bid shall be returned without action unless the substation provides a cost saving to the Owner while maintaining all project requirements, in the Architect's sole discretion.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be submitted via the procurement website (www.pennbid.net) at least fourteen days prior to the date for receipt of Bids (the Bid Date). 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 posed to the procurement website (www.pennbid.net).

§ 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 electronically via the Pennbid Program (www.pennbid.net), and shall include completion of the electronic Bid Forms within Pennbid, as well as uploading of the required supporting documentation.

§ 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 Intentionally Omitted.

§ 4.1.4 Intentionally Omitted.

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

§ 4.1.9 Owner may elect to disqualify a Bid due to failure to submit the Bid in the form requested/required, failure to Bid alternates or unit prices, failure to complete all entries, or inclusion in the Bid of anything not required or called for.

§ 4.2 Bid Security

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

Bid security shall be submitted with each bid in the amount of Ten Percent (10%) of the bid amount, and shall be in the form of a Bid bond. Bidder must provide an executed AIA A310-2010 – Bid Bond with submission of the Bid. No bids may be withdrawn for a period of 90 days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

§ 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 90 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:

Through the Pennbid website (www.pennbid.net)

§ 4.3.2 Intentionally Omitted.

§ 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 Bids may be modified or withdrawn through Pennbid at any time prior to the due date and time listed in the Invitation to 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.

§ 4.4.2.1 Such modifications to or withdrawal of a bid may only be made by persons authorized to act on behalf of the Bidder. Authorized persons are those so identified in the Bidder's corporate bylaws, specifically empowered by the Bidder's charter or similar legally binding document acceptable to Owner, or by a power of attorney, signed and dated, describing the scope and limitations of the power of attorney. Bidder must make such documentation available to Owner at the time of seeking modifications or withdrawal of the Bid.

§ 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, 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 returned to the Bidder.

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

Bids properly identified and received within the specified time limits shall be tabulated and available for registered participants of the procurement website (www.pennbid.net) to view.

§ 5.2 Rejection of Bids

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

§ 5.2.1 Owner specifically reserves the right to reject any Bid based on Owner and/or Architect's evaluation of the information submitted following opening of bids. Owner and/or Architect's evaluation of the Bidder's qualifications will include: status of licensure and record of compliance with licensing requirements, record of quality of completed work, record of project completion, project completion ability, record of financial management including financial resources available to complete Project and record of timely payment of obligations, record of project site management including compliance with requirements of authorities having jurisdiction, record of and number of current claims and disputes and the status of their resolution, and qualifications of the Bidder's proposed Project staff and proposed subcontractors.

§ 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 The Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Additionally, the Bidder shall furnish a Maintenance Bond and a Wage Rate Compliance Bond.

§ 7.1.1.1 Both a Performance Bond and a Payment Bond will be required, each in an amount equal to 100% of the Contract Sum.

§ 7.1.1.2 The Maintenance Bond will be required in the amount of 15% of the Contract Sum and shall be in force for a duration of 18 months from the date of Substantial Completion.

§ 7.1.2 The cost of furnishing all such bonds shall be included in the Bid.

§ 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.

§ 7.2 Time of Delivery and Form of Bonds

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner prior to the date of execution of the Contract, and shall be included as attachments to the Contract.

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

§ 7.2.2.1 The Maintenance Bond and Wage Rate Compliance Bond shall be on the form provided.

§ 7.2.3 All bonds shall be executed and be in force and full effect on the date of execution 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

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

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

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

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda:

Addenda shall include all addenda issued through the bidding period of the project from availability of the bidding documents up to the Bid Date and Time. A List of all
addenda shall be included within the Bidders Bid.

.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

DOCUMENT 002313 - GENERAL CONDITIONS FOR THE CONTRACT FOR CONSTRUCTION

1.1 GENERAL CONDITIONS FOR THE CONTRACT FOR CONSTRUCTION

A. Prime Contractors to utilize AIA forms outlined in this section. Contractors shall be required to purchase and provide all AIA documents outlined within this section.

B. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732

C. Document A201, "General Conditions of the Contract for Construction" is hereby incorporated into the Procurement and Contracting Requirements by reference.

1. A draft copy of AIA Document A201-2017, "General Conditions of the Contract for Construction" is bound in this Project Manual.
   a. Contractor(s) shall make modifications to the AIA Document A201-2017 – General Conditions of the Contract for Construction per modifications indicated in the Owner provided draft copy, per Section 002313a – “AIA A201-2017 General Conditions of the Contract for Construction - DRAFT.”

END OF DOCUMENT 002313

DRAFT

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

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

Cumru Township Fire Department»
Cumru Township, Pennsylvania
Berks County

THE OWNER:
(Name, legal status and address)

Cumru Township
1775 Welsh Road
Mohnton, Pennsylvania
Telephone Number: (484) 256-7290

THE ARCHITECT:
(Name, legal status and address)

Manns Woodward Studios, Subchapter S Corporation»
10839 Philadelphia Road
White Marsh, Maryland 21162
Telephone Number: 410-344-1460
Fax Number: 443-403-2460

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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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1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3, 13.2, 13.3.2, 15.4.4.2
Written Interpretations
4.2.11, 4.2.12
Written Orders
1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. The Contract Documents also 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, and portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

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

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

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

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set

forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document 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 entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

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

§ 2.3 Information and Services Required of the Owner

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

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

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

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

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

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

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

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

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

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

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

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations.

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

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

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

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

§ 3.5 Warranty

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

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

§ 3.6 Taxes

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

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

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

Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 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; and
- **.3** whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

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

§ 3.9 Superintendent

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

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

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

§ 3.11 Documents and Samples at the Site

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

§ 3.14 Cutting and Patching

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

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

§ 3.15 Cleaning Up

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

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

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in

Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

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

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

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

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any

direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

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

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

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

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

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

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

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

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

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

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with

reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

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, within five (5) days after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

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

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

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

§ 5.3 Subcontractual Relations

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

§ 5.4 Contingent Assignment of Subcontracts

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

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under any bond(s) relating to the Contract.

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

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

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

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

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

§ 6.2 Mutual Responsibility

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

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

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

§ 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 that are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

§ 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.

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

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

§ 7.4 Minor Changes in the Work

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

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

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

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

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

§ 8.3 Delays and Extensions of Time

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

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

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

§ 8.3.4 Liquidated Damages for Delay

Where the Contractor has not completed the work within the stipulated Contract Time, including delays and extensions of time as outlined in Section 8.3, the Owner shall assess liquidated damages against the Contractor for which the Contractor shall be liable for and responsible to pay to the Owner either by adjustment of the Contract Sum or by direct payment to the Owner. Liquidated damages shall be assessed at $1,000.00 per day for every calendar day the work is not complete beyond the scheduled date of final completion.

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

§ 9.2 Schedule of Values

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

§ 9.3 Applications for Payment

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

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

§ 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 be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

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

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

§ 9.5 Decisions to Withhold Certification

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

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

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** repeated failure to carry out the Work in accordance with the Contract Documents.

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

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

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

§ 9.6 Progress Payments

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

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

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

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

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

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

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

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

§ 9.7 Failure of Payment

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

§ 9.8 Substantial Completion

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

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

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

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

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

§ 9.9 Partial Occupancy or Use

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

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

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

§ 9.10 Final Completion and Final Payment

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

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

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

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

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

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

§ 9.11 Retainage

Each Application for Payment shall include retainage of ten percent (10%) of the requested payment. Upon completion of seventy five percent (75%) of the Work, as determined by the Architect, the Owner may, in its sole discretion, reduce the retainage to five percent (5%) for the remainder of the Contract Time.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

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

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

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

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

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

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents or applicable law 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 was not rendered harmless pursuant to Section 10.3.2 after discovery, 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 or misconduct on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor, and any Subcontractors,shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents. Contractor shall require all Subcontractors furnish evidence of equivalent insurance coverage prior to commencement of work by the Subcontractor. In no event shall the failure to provide this proof, prior to the commencement of the Work, be deemed to be a waiver by Subcontractor's insurance obligation as listed set forth herein.

§ 11.1.1.1 Contractor's Insurance Requirements

1. Comprehensive General Liability - For bodily injury and property damage - including any liability normally covered by a general liability policy with limits of not less than $1,000,000 per occurrence and $2,000,000 in the annual aggregate. Contractor's policy must name the Township of Cumru, its elected officials, agents and employees as Additional Insureds on a Primary and Non-Contributory basis, as well as include a Waiver of Subrogation in favor of the Township of Cumru, its elected officials, agents and employees.
2. Business Automobile Liability - For owned, non-owned, and leased vehicles with a combined single limit of not less than $1,000,000 for bodily injury and property damage. Contractor's policy must name the Township of Cumru, its elected officials, agents and employees as Additional Insureds on a Primary and Non-Contributory basis, as well as include a Waiver of Subrogation in favor of the Township of Cumru, its elected officials, agents and employees.
3. Professional Liability - In minimum amounts of $1,000,000 per occurrence and $2,000,000 aggregate. Contractor's policy must name the Township of Cumru, its elected officials, agents and employees as Additional Insureds on a Primary and Non-Contributory basis, as well as include a Waiver of Subrogation in favor of the Township of Cumru, its elected officials, agents and employees.
4. Workers Compensation - Statutory limits in each state in which Contractor is required to provide Worker's Compensation coverage including "All States" and "Voluntary Compensation" endorsements, and shall include a Waiver of Subrogation against the Township of Cumru, its elected officials, agents and employees.
5. Employer's Liability - With limits not less than $100,000 Accident - Each, $100,000 Disease - Each Employee, and $500,000 Disease - Policy Limit.
6. Umbrella Coverage (to overlay General Liability, Auto Liability and Employer's Liability Coverages – we would recommend a limit of at least $1,000,000 Each Occurrence and $1,000,000 Aggregate but this limit can be higher if you feel it should be. I would tend to increase the limit to at least $4,000,000 for the project.
7. Contractor's Pollution Liability - $1,000,000 Each Loss; $1,000,000 Aggregate Limit. Contractor's policy must name the Township of Cumru, its elected officials, agents and employees as Additional Insureds on a Primary and Non-Contributory basis, as well as include a Waiver of Subrogation in favor of the Township of Cumru, its elected officials, agents and employees.

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

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

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

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

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

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

§ 11.3 Waivers of Subrogation

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

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment

property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

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

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

§11.5 Adjustment and Settlement of Insured Loss

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

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

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect for 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, at the Contractor's expense

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the laws of the Commonwealth of Pennsylvania. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

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

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

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

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

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

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

§ 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; and reasonable costs incurred by reason of the termination, including reasonable costs attributable to termination of Subcontracts.

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. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

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

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

§ 15.1.4 Continuing Contract Performance

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

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

§ 15.1.5 Claims for Additional Cost

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

§ 15.1.6 Claims for Additional Time

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

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

§ 15.1.7 Waiver of Claims for Consequential Damages

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

- **.1** damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- **.2** damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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

§ 15.2 Initial Decision

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

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

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

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

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision

Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

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

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

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

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

§ 15.3 Mediation

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

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

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

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

§ 15.4 Arbitration

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

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

written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

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

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

§ 15.4.4 Consolidation or Joinder

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

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

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

DOCUMENT 002413 - SUPPLEMENTARY GENERAL CONDITIONS

1.1 ARTICLE 3 - CONTRACTOR

A. Amend 3.7 Permits, Fees, Notices, and Compliance with Laws to read:

1. 3.7 - Permits, Fees, Notices, and Compliance with Laws: Unless otherwise provided in the Contract Documents, The Contractor shall secure and pay for all required 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.

B. Add Section 3.7.1

1. 3.7.1 - The General Contractor (1A) shall be responsible for obtaining the projects approved General Building (non-trade specific) Permit. Permit fees for the permit shall not be included within the Bid. The Owner, assisted by both the Construction Manager and the Architect, shall apply for the general building (non-trade specific) permit and respond to all general building permit review comments to gain approval of the general building permit.

1.2 ARTICLE 8 - TIME

A. Add Section 8.1.1.1

1. 8.1.1.1 - Contractors shall include within their schedules anticipated weather/precipitation days per month as calculated utilizing NOAA Comparative Climatic Data Mean Number of Days with Precipitation 0.01 Inch or More. This information below is adjusted to remove, based on a percentage of weekend calendar days, the anticipated weather/precipitation days; January- 8, February-7, March-8, April-8, May-8, June-8, July-7, August-7, September-6, October-6, November-7, December-8. Extensions of time based upon weather delays shall only be considered where the cumulative number of weather/precipitation days indicated above is exceeded per annum.

1.3 ARTICLE 9 - PAYMENTS AND COMPLETION

A. Add Section 9.11.2

1. 9.11.2 - Retainage MAY be reduced after Substantial Completion to an amount determined by the Architect and Owner and only where the completion of the punchlist work is progressing to the satisfaction of the Construction Manager, Architect and Owner. Reduction of retainage is not guaranteed.

B. Add Section 9.11.3

1. 9.11.3 - Final release of retainage for each Prime Contract respectively will not be approved until after Final Completion of the Work has been achieved by each Prime Contractor respectively. Final Completion of the Work shall include but is not limited to the submission and approval of all O&M manuals and other closeout documents and all punchlist items have been completed and accepted.

END OF DOCUMENT 002213

DOCUMENT 002513 – MANDATORY PREBID MEETING

1.1 PREBID MEETING

A. Construction Manager will conduct a non-mandatory Prebid meeting as indicated below:

1. Meeting Date: December 14th 2023.
2. Meeting Time: 1:00 pm, local time.
3. Location: Ground floor lobby, Cumru Township Building, 1775 Welsh Road, Mohnton PA 19540, .

B. Attendance:

1. Prime Contractor Bidders: Attendance at Prebid meeting is mandatory.

C. Bidder Questions: Statements made during the prebid meeting shall be non-binding. All Bidders shall submit questions in writing through the procurement website. Responses to questions shall be provided through addendum.

D. Agenda: Prebid meeting agenda will include review of topics that may affect proper preparation and submittal of bids, including the following:

1. Procurement and Contracting Requirements:

a. Advertisement for Bids.
b. Instructions to Bidders.
c. Bonding.
d. Insurance.
e. Bid Security.
f. Bid Form and Attachments.
g. Bid Submittal Requirements.
h. Notice of Award.

2. Communication during Bidding Period:

a. Obtaining documents.
b. Bidder's Requests for Information.
c. Addenda.

3. Contracting Requirements:

a. Agreement.
b. The General Conditions.
c. The Supplementary Conditions.

4. Construction Documents:

a. General Scopes of Work.
b. Temporary Facilities.
c. Use of Site.
d. Work Restrictions.

5. Schedule:
   a. Contract Time.
   b. Liquidated Damages.

6. Building pad visit.
7. Post-Meeting Addendum.

END OF DOCUMENT 002513

DOCUMENT 002600 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.

B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 2500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 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.

1.3 PROCUREMENT SUBSTITUTIONS

A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.

B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

A. Procurement Substitution Request: Submit request via procurement website. Procurement Substitution Requests must made in writing in compliance with the following requirements:

1. Requests for substitution of materials and equipment will be considered if received no later than 14 days prior to date of bid submission.
2. Submittal Request Format: Submit completed substitution request form bound in project manual following Section 01 2500 "Substitution Procedures."

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 002600

DOCUMENT 003119 - EXISTING CONDITION INFORMATION

1.1 EXISTING CONDITION 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 the 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. Existing drawings that include information on existing conditions including previous construction efforts for the Cumru Township Utility and Fire Station Building Pad at Project site are available for viewing on Project Web site, as found on PennBid.

C. Daily Reports and Project Observations of existing building pad conditions that includes photographic documentation on existing conditions, and soil density testing, prepared by Atlas Technical Consultants, LLC, dated April 13th 2022 through November 10th 2022, is available on the Project Web site, as found on PennBid.

D. Related Requirements:

1. For download on PennBid as independent document: As-Built Drawings Cumru Township Utility and Fire Station Building Pad Project
2. For download on PennBid as independent document: Daily Report/Project Observations – Fire Station Building Pad Project
3. For download on PennBid as independent document: Compaction and Particle Size Distribution Report – Fire Station Pad Project

4. Document 003132 "Geotechnical Data" for reports and soil-boring data from geotechnical investigations that are made available to bidders.

END OF DOCUMENT 003119

DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

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. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project, prepared by ECS Mid-Atlantic, LLC, dated January 17, 2019, is available for viewing as appended to this Document.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

D. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
2. Document 003132a “Geotechnical Report” for the geotechnical report.

END OF DOCUMENT 003132

ECS Mid-Atlantic, LLC

Geotechnical Engineering Report

Cumru Township Fire Station

1775 Welsh Road
Mohnton, Cumru Township, Berks County, Pennsylvania

ECS Project Number 18:4591-A

January 17, 2019

ECS MID-ATLANTIC, LLC
"Setting the Standard for Service"
Geotechnical • Construction Materials • Environmental • Facilities

January 17, 2019

Mr. Evan Gray, AIA
Manns Woodward Studios
10839-D Philadelphia Road
White Marsh, Maryland 21162

ECS Project No. 18.4591-A

Reference: Subsurface Exploration and Geotechnical Engineering Services
Cumru Township Fire Station
Mohnton, Pennsylvania

Dear Mr. Gray:

ECS Mid-Atlantic, LLC (ECS) has completed the subsurface exploration and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our Proposal No. 18.6657-GP, dated November 16, 2018. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration, laboratory testing, and our design and construction recommendations.

It has been our pleasure to be of service to Manns Woodward Studios during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Mid-Atlantic, LLC

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- Geologic Map
- Boring/Test Pit Location Map
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EXECUTIVE SUMMARY

The geotechnical exploration was performed for the planned development of the Cumru Township Fire Station in Mohnton, PA. The purpose of this study was to provide geotechnical information for the design of a single story fire station and the corresponding stormwater management facilities. This exploration was completed by performing a total of fourteen (14) exploratory soil borings, with cased borehole infiltration testing being conducted in five (5) of them.

The soil borings encountered between 2 and 6 inches of topsoil generally underlain by LEAN CLAY with Sand. Beneath the LEAN CLAY layer was generally SAND. The SAND layer extended to the bottom of boring depths ranging from 6 to 20 feet below grade.

In general, the site exhibits unfavorable infiltration rates. While minor amounts of infiltration may occur in the natural soils, we recommend that stormwater management for this property consist of volume and rate control combined with water quality measures using BMP facilities. For design purposes we recommend that stormwater management facilities consist of BMP areas for water quality with underdrains in the stormwater management facilities to convey the water offsite.

Site preparation should anticipate undercutting of 2 feet in the building pad due to soft surficial materials. We also recommend that the finished floor elevation be increase to approximately Elev. 340.0 feet.

The proposed building can be supported by conventional shallow foundations consisting of column or strip footings bearing on the existing soils. The foundations can be designed for an allowable soil bearing pressure of 2,000 psf based on anticipated dead load and design live load. All excavations for the footings should be undercut and widened on each side a minimum of 2 feet and backfilled with compacted 2A stone.

Groundwater was encountered in every boring location with the exception of B-11, B-13 and B-14 during the subsurface exploration and should be a concern within the general area tested for this part of the project. The groundwater table is located approximately 6 feet below existing ground elevation. Excavation depths for footings and utilities should remain above this depth if possible to limit construction issues.

Most of the on-site soils anticipated to be excavated are likely to be clayey with varying amounts of sand. All fine-grained soils encountered may be sensitive to moisture and will degrade quickly when wet. The excavated soils are not anticipated to be suitable for use as structural fill unless properly moisture conditioned.

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information for the design of the Cumru Township's fire station on the property adjacent to the existing township building. The project site is located at the address of 1775 Welsh Road in Mohnton, Pennsylvania.

The recommendations developed for this report are based on project information supplied by Manns Woodward Studios as well as the previous subsurface exploration. This report contains the results of our subsurface explorations and laboratory testing programs, site characterization, engineering analyses, and recommendations for the design and construction of proposed stormwater management facilities associated with the overall site development.

1.2 SCOPE OF SERVICES

Characterization of the subsurface conditions at this site is critical to the design development process. As requested, we have completed testing and exploration for characterization of the site for structural, geotechnical earthwork, and stormwater management recommendations. The scope of work for this phase of the project included exploratory borings and cased borehole infiltration testing within the proposed stormwater management areas. The first phase of testing ECS performed at this site in July 2018 for an alternate layout also included double ring infiltration testing in test pits in the general vicinity of the currently proposed building and stormwater management areas.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following.

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- Final copies of our boring and test pit logs.
- Infiltration testing results and recommendations for stormwater management.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills.
- Recommended foundation type(s).
- Evaluation and recommendations relative to groundwater control.
- A discussion of potential of karst geology issues.

It should be noted that ECS performed a previous phase of exploration at this site based on an alternate layout in July 2018. That exploration identified a series of geotechnical related problems associated with that site layout that led to the redesign of the site layout and to this current exploration.

1.3 AUTHORIZATION

Our services were provided in accordance with our Proposal No. 18.6657-GP, dated November 16, 2018, as authorized by Manns Woodward Studios.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION

The project site is located at the address 1775 Welsh Road in Mohnton, Pennsylvania. At the time of exploration, the site consisted of the current township building, a storage shed, a pavilion and a community building with two associated playgrounds. The site structures are all contained within a moderately wooded, grassy area.

The current township building resides on the southwest portion of the site. A stormwater basin, approximately 15 feet lower in elevation, is located approximately 150 feet to the north of the township building. The stormwater basin contains an outlet which allows the gathered water to drain to the grassy area where the new building is proposed. The total topographic relief across the project site is approximately 40 feet, sloping to the northeast.

Refer to Figure 2.1.1 and the Site Location Map in Appendix A for the extents of the project site.

Figure 2.1.1 Site Location

2.2 PAST SITE HISTORY

ECS reviewed historical aerial photographs available from Google Earth and Nationwide Environmental Title Research, LLC (NETR). Based on our review of the photographs, historically the general area was a heavily wooded area through the 1940's and 1950's. In the late 1960's, the surrounding roads were constructed along their current alignments. In the Early 1990's, the current township building was in place. In the early 2000's, construction began on the recreation

building at the North end of the site and the township building on the other side of Welsh Road. From the late 2000's to current day no significant changes occurred. No notable geologic or mining features were identified in the photographs reviewed.

2.3 PROPOSED CONSTRUCTION

It is our understanding that a single story fire station is to be constructed adjacent to the existing township building. The new fire station will include a drive-in garage in the front with an optional 4 bay return apron located in the rear. A parking lot and a paved courtyard will be located to the front and left side of the new building, respectively. The proposed floor grade is located at Elev. 338.0 feet. In order to mitigate construction issues and subgrade concerns, ECS recommends the finished floor grade be located at Elev. 340.0 feet. The existing topography beneath the proposed building pad ranges from Elev. 340.0 feet to Elev. 336.0 feet. The majority of the area beneath the building pad will require fill to reach grade. Structural load information for the structures were not available at the time of this study, but we expect column loads to be less than 50 kips and continuous wall loads of less than 2 kips per lineal foot.

3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate field and laboratory data to assist in the design of the foundations and stormwater management facilities.

3.1.1 Boring Data

The subsurface conditions were explored by drilling fourteen (14) test borings. Six (6) borings were located within the footprint of the proposed structure. Three (3) borings were located within the proposed courtyard and parking areas. A track-mounted drill rig was utilized to drill the test borings. For the proposed building, test borings were planned to be advanced to a depth of 20 feet below the existing ground surface or auger refusal, whichever encountered first. In addition, five (5) cased borehole infiltration tests were conducted in the proposed stormwater management areas. A bore hole was performed adjacent to each infiltration test location and was drilled two (2) feet below the designed testing depth to determine the absence of limiting zones. Subsurface explorations were completed under the general supervision of an ECS field geologist. An additional boring, designated as B-01*, was conducted during the first phase of subsurface exploration and has been included in this report due to its proximity to the proposed structure location.

Boring locations were identified in the field by ECS utilizing a Trimble Geo7x Global Positioning System (GPS). The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. Boring locations were adjusted in the field due to existing underground utilities and site conditions. Ground surface elevations noted on our boring logs were interpolated from the available land development plan provided by Manns Woodward Studios.

Standard penetration tests (SPTs) were conducted in the borings at regular intervals in general accordance with ASTM D 1586. Small representative samples were obtained during these tests and were used to classify the soils encountered. The standard penetration resistances obtained provide a general indication of soil shear strength and compressibility.

A summary of the boring data is included in the table below. It should be noted that the borings were drilled in a season of precipitation loads that were well above average, and some borings were situation in low-lying areas. It is therefore possible that some water levels recorded were affected by the surface water runoff.

Table 3.1.1.1 Summary of Boring Data

Boring Location	Surface Elevation (Feet)	Drilled Depth		Groundwater Depth	
		Depth (Feet)	Elev. (Feet)	Depth (Feet)	Elev. (Feet)
B-01	548.0	20.0	528.0	13.0	535.0
B-02	539.0	20.0	519.0	13.0	526.0
B-03	540.0	20.0	520.0	13.0	527.0
B-04	539.0	20.0	519.0	13.0	526.0
B-05	539.0	20.0	519.0	0.0[4]	539.0[4]
B-06	536.0	20.0	516.0	6.0	530.0
B-07	537.5	20.0	517.5	13.0	524.5
B-08	5390	20.0	519.0	18.0	521.0
B-09	536.5	19.0	517.5	6.0	530.5
B-10	538.5	8.0	530.5	7.0	531.5
B-11	536.0	6.0	530.0	NE	NA
B-12	536.0	4.0	532.0	NE	NA
B-13	540.0	6.0	534.0	NE	NA
B-14	545.0	6.0	539.0	NE	NA
B-01*	544.0	15.0	529.0	NE	NA

Note[1]: NE: Not Encountered, NA: Not Applicable
Note[2]: Elevations were determined by interpolation of provide site plan
Note[3]: (*) completed during phase 1
Note[4]: Due to surface water in borehole

The results of the subsurface exploration, along with the Boring Location Map, are included within the Appendix of this report.

3.1.2 Stormwater Infiltration Testing

The infiltration testing was completed using the double ring infiltration method and the cased borehole infiltration method in general according with the Pennsylvania Stormwater Best Management Practices (PA BMP) Manual and the Maryland Stormwater Design Manual. Five cased borings, designated as B-10 through B-14, were completed. In addition, five (5) test pits were completed using double ring infiltration during the first phase of subsurface exploration and have been included due to their proximity to the proposed structure. A one-hour presoak was utilized at each test location to determine the testing interval. Test reading were recorded at 10 or 30 minutes intervals according to the presoak infiltration rates. A minimum of four (4) consecutive average stabilized reading were recorded. The soils tested were not saturated or frozen during the rime of testing. Precipitation did not occur on the days immediately prior to, or during testing. The soil was classified a minimum of 2 feet below the testing elevation to check for limiting zones. The Infiltration tests are provided in the following table.

Table 3.1.2.1 Infiltration Testing Results

Test Location	Surface Elevation (Feet)	Depth to Limiting Zone (Feet)	Limiting Layer Elevation (Feet)	Infiltration Test Depth (Feet)	Test Elevation (Feet)	Design Infiltration Rate (in/hr) (Includes FS = 2.0)
B-10	538.5	7.0	531.5	5.0	533.50	0.00
B-11	536.0	NE	NA	4.0	532.00	0.00
B-12	536.0	NE	NA	2.0	534.00	0.00
B-13	540.0	NE	NA	4.0	536.00	0.06
B-14	545.0	NE	NA	4.0	541.00	0.51
TP-0*	537.0	8.8	528.2	1.0	536.0	1.19, 1.69
TP-1*	533.0	6.8	526.2	NA	NA	NA
TP-2*	533.0	5.2	527.8	NA	NA	NA
TP-3*	536.0	6.2	529.8	NA	NA	NA
TP-4*	545.0	6.8	538.2	3.0	542.0	0.02

Note[1]: NE: Not Encountered, NA: Not Applicable
Note[2]: Elevations were determined by interpolation of provide site plan.
Note[3]: (*) completed during phase 1

3.2 REGIONAL/SITE GEOLOGY

According to the Pennsylvania Department of Conservation and Natural Resources Interactive Map (PA DCNR), the site is underlain by The Diabase Formation (TrD). The *Engineering Characteristics of the Rocks of Pennsylvania, Second Edition*, 1982, by Alan Geyer and Peter Wilshusen, states that the Diabase formation is a dark gray to black, dense, and very fine grained, and consists of 90 to 95 percent labradorite and augite. The joints have blocky pattern; well developed; moderate distance between fractures. The bedrock formation is highly resistant; slightly weathered to a shallow depth. This formation possesses fair surface drainage. Joint openings provide a very low secondary porosity and low permeability. The bedrock is difficult to excavate with large boulders being a problem with an associated slow drilling rate. The cut-slope and foundation stability provided by this bedrock is good.

An overview of the general site geology is illustrated in Figure 3.2.1 below.

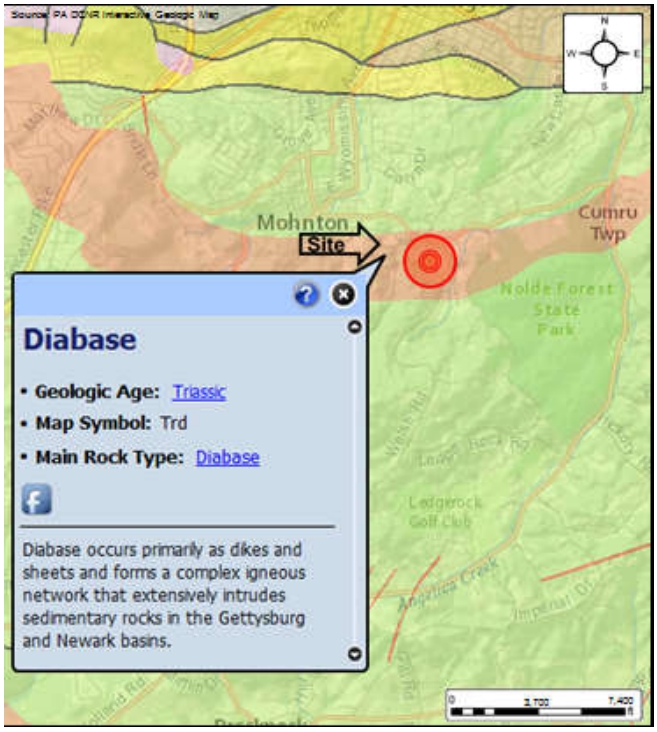


Figure 3.2.1

Geologic map for Figure 3.2.1 obtained from the Commonwealth of Pennsylvania Department of Conservation and Natural Resources Interactive Geologic Map website, http://www.gis.dcnr.state.pa.us/geology/index.html

3.3 SITE PHYSIOGRAPHY

The site is situated in the Gettysburg Newark Lowland section of the Piedmont Physiographic Province in south central Pennsylvania. This section generally consists of rolling lowlands, shallow valleys, and isolated hills. This section is primarily developed on red shale, siltstone, and sandstone bedrock. Elevations in this section range from 20 to 1,355 feet, and local relief is generally low to moderate. Drainage is dendritic and trellis in pattern for this section.

3.4 SOIL SURVEY MAPPING

Our review of the Soil Survey (USDA - Natural Resources Conservation Service websoilsurvey.ncrs.usda.gov), revealed that the proposed site is mapped as Neshaminy Silt Loam and Neshaminy Gravelly Silt Loam. These soil types are described as having the following properties.

Table 3.4.1 Soil Mapping Summary

Mapped Soil Unit	Soil Unit Symbol	Origin/Type	Depth to Restrictive Feature	Depth to Water Table (Feet)	Hydrologic Soil Group	Ksat (in/hr)
Neshaminy Silt Loam (8-15 percent slopes)	NaC	Residuum weathered from diabase	48 - 80 inches to lithic bedrock	> 80 inches	C	0.20-0.60
Neshaminy Silt Loam (3-8 percent slopes)	NaB	Residuum weathered from diabase	48 - 80 inches to lithic bedrock	> 80 inches	C	0.20-0.60
Neshaminy Gravelly Silt Loam	NhD	Residuum weathered from diabase	48 - 80 inches to lithic bedrock	> 80 inches	C	0.20-0.60

Soil mapping of the site vicinity is presented in Appendix A.

3.4.1 Subsurface Stratigraphy

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil strata encountered during our subsurface exploration. For subsurface information at a specific location, refer to the Test Pit Logs in Appendix B

Table 3.5.1.1 Subsurface Stratigraphy

Stratum	Description
Surficial Material	Exploratory Borings revealed that the surficial material at these sites ranged from 2 to 6 inches of topsoil.
I	Generally, (CL) LEAN CLAY with Sand • Some areas of FILL were encountered ranging from 0.3 to 8.0 feet below existing grade. • Moist to wet, brown, gray and tan • Very soft to very stiff • Extended to depths approximately 2.0 to 13.0 feet below existing grade
II	Generally, (SP) SAND • Dry to wet, brown, tan and gray • Loose to very dense • Extended to end of boring depths approximately 6.5 to 20.0 feet below existing grade

3.5 GROUNDWATER OBSERVATIONS

During exploration, groundwater was observed in every boring with the exception of B-11, B-13 and B-14. Groundwater was encountered between 0.0 and 18.0 feet below existing grade. Observations for groundwater were performed for each soil boring location during our exploration program. It should be noted that the groundwater elevation will be highly affected by precipitation. Therefore, higher or lower groundwater levels may be encountered depending on

the time of year and recent precipitation events. Areas of perched groundwater on top of the existing clay soils may also be encountered at the site. It should be noted that the borings were drilled in a season of precipitation loads that were well above average, and some borings were situation in low-lying areas. It is therefore possible that some water levels recorded were affected by the surface water runoff.

Due to the high water table present at the project site, groundwater should be a major concern during construction. More specifically, excavation for utility trenches may be located beneath the groundwater table. Refer to Section 6.4 for more information.

4.0 LABORATORY TESTING

The laboratory testing performed by ECS for this project consisted of selected tests performed on samples obtained during our field exploration operations. The following paragraph briefly discusses the laboratory testing program. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties.

An experienced field geologist visually classified each soil sample from the test borings/pits on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) and ASTM D-2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the field geologist grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring/test pit logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual.

Laboratory testing performed specifically for this project included moisture content determination, Atterberg Limits, and grain size analyses to determine the USCS classification of the soils. A summary of the laboratory testing is located below.

Table 4.1 Summary of Soil Classification Testing Results

Boring	Depth (Feet)	USCS Classification	Water Content (%)	Atterberg Limits		Grain Size			
				Liquid Limit	Plastic Index	%Gravel	%Sand	%Silt	%Clay
B-01	6.00-8.00	CL	20.1	29	8	6.7	38.9	54.4	
B-05	4.00-6.00	CL	20.0	42	19	0.0	10.5	89.5	
B-06	4.00-6.00	SC-SM	6.9	25	4	7.7	55.8	28.7	7.8
B-13	2.00-4.00	CL	25.6	29	8	3.0	19.4	54.1	23.5

5.0 DESIGN RECOMMENDATIONS

5.1 SITE DESIGN

The subsurface exploration performed at the site indicate existing LEAN CLAY soils are expected at the foundation, floor slab, and pavement subgrade levels. The following sections provide recommendations for foundation design, soil supported slabs, s, and seismic design parameters.

5.1.1 Foundations

Provided subgrades and structural fills are prepared as discussed herein, the proposed structures can be supported by conventional shallow foundations consisting of individual column footings and continuous wall footings. The design of the foundation shall utilize the following parameters:

Table 5.1.1.1 Foundation Design Parameters

Design Parameter	Column Footing	Wall Footing
Net Allowable Bearing Pressure[1]	2,000 psf	2,000 psf
Acceptable Bearing Soil Material	Stratum I (CL)	Stratum I (CL)
Minimum Width	24 inches	18 inches
Minimum Footing Embedment Depth (below slab or finished grade)	36 inches	36 inches
Estimated Total Settlement	1 inch	1 inch
Estimated Differential Settlement	Less than 0.5 inches between columns	Less than 0.5 inches over 50 feet

Note[1]: Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.

Most of the soils at the foundation bearing elevation are anticipated to have elevated moisture contents and therefore would be marginal in their capacity to support foundation loads unless additional stabilization measures are performed. In order to provide foundation subgrade stabilization, foundation soils should be planned to be undercut a minimum of 2 feet. If further fill or soft or unsuitable soils at the undercut elevations, the unsuitable soils should be undercut and removed. All undercuts should be backfilled with compacted 2A aggregate to the designed bearing elevation. All foundation undercut excavations should be widened 1 foot on each side for every foot of over excavation (equivalent to a 1(H):1(V) slope for improved bearing area). The subgrade stabilization should be performed using the Footing Subgrade Repair Detail in Appendix B. The foundations bearing on suitable material can be designed for an allowable soil bearing pressure of 2,000 psf based on anticipated dead load and design live load.

5.1.2 Floor Slabs

Most of the soils at the floor slab bearing elevation are anticipated to have elevated moisture contents and therefore would be marginal in their support capacities unless additional stabilization measures are performed. In order to provide subgrade stabilization, all soils in the floor slab footprint should be planned to be undercut a minimum of 2 feet during the site preparation process. If further fill or soft or unsuitable soils at the undercut elevations, the

unsuitable soils should be undercut and removed. All undercuts should be backfilled with compacted structural fill to the designed bearing elevation. Undercutting is expected to be necessary across the entire pad as a part of site permeation. Refer to Section 6.1 for additional recommendations. The slab subgrade should be evaluated by proofrolling in accordance with Section 6.1.2. The following graphic depicts our soil-supported slab recommendations:

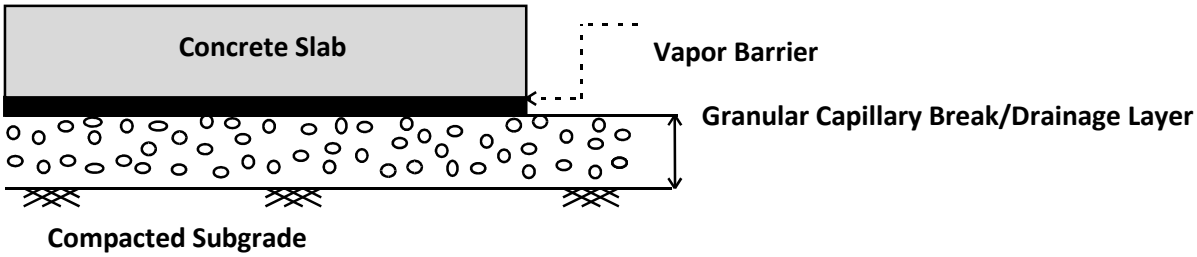


Figure 5.1.2.1

1. Drainage Layer Thickness: 6 inches minimum
2. Drainage Layer Material: AASHTO #57 Stone
3. Subgrade compacted to ***95%*** maximum dry density per ASTM D698

Subgrade Modulus: Provided the evaluation bearing stratum and Granular Drainage Layer are completed per the recommendations discussed herein, the slab may be designed assuming a modulus of subgrade reaction, k_1, of 100 pci (lbs/cu. inch). The modulus of subgrade reaction value is based on a 1 foot by 1 foot plate load test basis.

Slab Isolation: Ground-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab.

5.1.3 Below Grade Walls and Site Retaining Walls

We recommend that all below grade and site retaining walls be designed to withstand lateral earth pressures and surcharge loads from soil. To accomplish a drained condition, the walls will need to incorporate appropriate drainage materials including a foundation drain and clean stone (AASHTO #57). We recommend that walls that are restrained from movement at the top be designed for a linearly increasing lateral earth pressure.

The engineering soil parameters below can be used for the design of these walls assuming positive foundation drainage is provided to prevent buildup of hydrostatic pressure. The table also assumes that the walls will be backfilled with Structural fill materials obtained from on-site cut areas or brought in from off-site. The fills should be granular materials that classify as Silty SAND (SM) or more granular soil types having an internal angle of friction of 30 degrees and a unit weight of 120 pcf. Wall backfill should not consist of clayey soil types.

Table 5.1.3.1 – Engineering Soil Parameters

Parameter	Structural Fill
Moist unit weight (pcf)	120
Friction angle (degrees)	30
Cohesion (psf)	0
Active Earth Pressure Coefficient, K_a	0.33
At-Rest Earth Pressure Coefficient, K_o	0.50
Passive Earth Pressure Coefficient, K_p	3.0
Coefficient of Friction for Sliding	0.30

The following Figure depicts the suggested lateral earth pressure condition for a "drained" wall condition with restrained wall tops:

This diagram is not suitable for the design of Support of Excavation or temporary shoring systems.

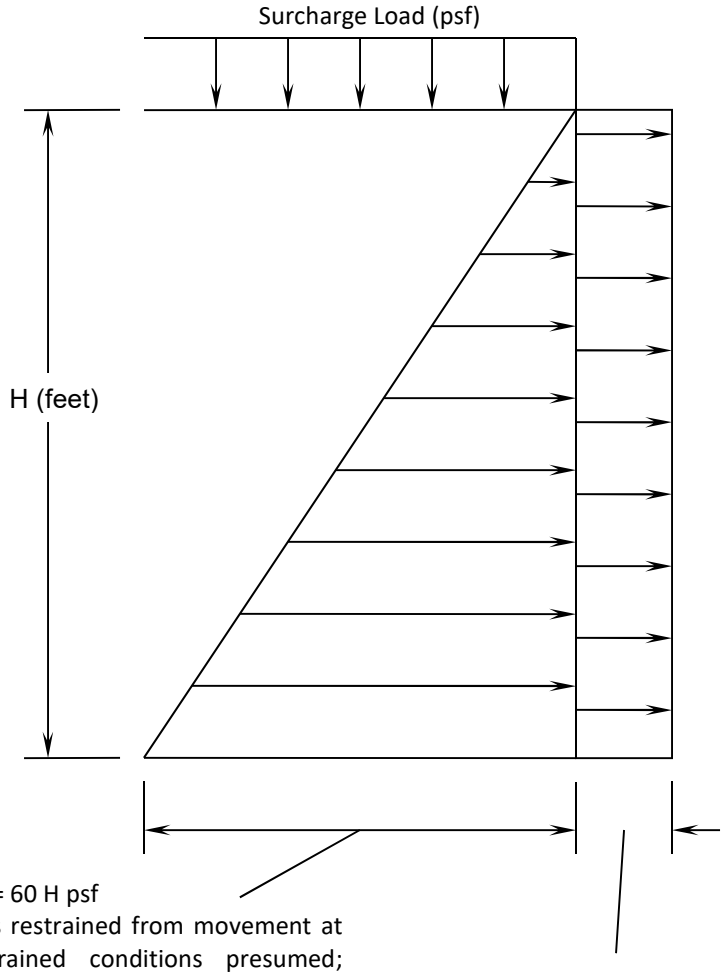


Figure 5.1.3.1

Any surcharge loads imposed within a 45 degree slope of the base of the wall should be considered in the below grade wall design.

Backfill of foundation walls and retaining walls should consist of granular material. The backfill materials should be placed in 8-inch thick loose layers and compacted to 95 percent of the standard Proctor maximum dry density. We recommend that backfill directly behind the walls be compacted with hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 10 feet of the wall during backfilling to avoid developing excessive temporary or long-term lateral soil pressures. We recommend that a representative of the geotechnical engineer be present to monitor foundation excavations and fill placement. Below grade walls should also be designed to resist adjoining surcharge loads from foundations, equipment, and/or vehicle traffic located in the zone of influence of the wall.

5.1.4 Seismic Design Considerations

Seismic Site Classification: The International Building Code (IBC) requires site classification for seismic design based on the upper 100 feet of a soil profile. Where site specific data are not available to a depth of 100 ft, appropriate soil properties are permitted to be estimated by the registered design professional preparing the soils report based on known geologic conditions. Three (3) methods are utilized in classifying sites, namely the shear wave velocity (v_s) method; the undrained shear strength (s_u) method; and the Standard Penetration Resistance (N-value) method.

The seismic site class definitions for the weighted average of shear wave velocity or SPT N-value in the upper 100 feet of the soil profile are shown in the following table:

Table 5.1.3.1 Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave Velocity, Vs, (ft./s)	N value (bpf)
A	Hard Rock	Vs > 5,000 fps	N/A
B	Rock	2,500 < Vs ≤ 5,000 fps	N/A
C	Very dense soil and soft rock	1,200 < Vs ≤ 2,500 fps	>50
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200 fps	15 to 60
E	Soft Soil Profile	Vs < 600 fps	<15

The subsurface exploration at this site included drilling borings and excavated test pits to depths of 4.0 to 20.0 feet below the existing site grades. Because there is no reason to believe Site Class E or F is likely to be present on site, it is our recommendation, based on the International Building Code, that the site can be classified as **Site Class D**. ECS can provide additional analysis and testing, if desired, to further evaluate the site class or to develop site specific response spectra.

Liquefaction: The subsurface profile consists primarily of residual soils derived from the in-place weathering of the underlying bedrock. The subsurface conditions do not appear to exhibit liquefaction potential; therefore, it is our opinion that additional investigation regarding liquefaction potential is not necessary.

Ground Motion Parameters: In addition to the seismic site classification noted above, ECS has determined the design spectral response acceleration parameters following the IBC 2015 methodology. The Mapped Reponses were estimated from the free Java Ground Motion Parameter Calculator available from the USGS website

(http://earthquake.usgs.gov/designmaps/us/application.php). The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far right end of the following table.

Table 5.1.3.2 Ground Motion Parameters *(IBC 2015 Method)*

Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
IBC Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.207	F_a	1.6	$S_{MS}=F_aS_s$	0.331	$S_{DS}=2/3\ S_{MS}$	0.220
1.0	S_1	0.054	F_v	2.4	$S_{M1}=F_vS_1$	0.130	$S_{D1}=2/3\ S_{M1}$	0.087

The Site Class definition should not be confused with the Seismic Design Category designation, which the Structural Engineer typically assesses. If a higher site classification is beneficial to the project, ECS would be pleased to discuss additional testing capabilities in this regard.

5.2 SITE DESIGN CONSIDERATIONS

5.2.1 Pavement Sections

Subgrade Characteristics: Based on the results of our subsurface exploration, it appears that the soils that will comprise pavement subgrades, exposed in cuts and placed as fill, will consist mainly of existing lean clay material or new structural fill. These soil will provide poor to fair pavement support. We did not perform CBR testing on the soils expected at pavement subgrade levels, but these soils typically demonstrate a minimum CBR value on the order of 3. For design purposes, a CBR value of 3 has been selected. The pavement design assumes subgrades consist of suitable materials evaluated by ECS and placed and compacted to at least 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D 698) in accordance with the project specifications.

5.2.2 Flexible (Bituminous) Pavement

The recommended pavement thicknesses presented in this report section are considered typical and minimum for the assumed parameters in the general site area. We understand that budgetary considerations sometimes warrant thinner pavement sections than those presented. However, the client, the owner, and the project designers should be aware that thinner pavement sections may result in increased maintenance costs and lower than anticipated pavement life.

Because of the anticipated use of the planned pavement areas associated with the industrial building, we have assumed that medium and heavy duty pavement sections will be required. The light duty pavement section will be utilized in the parking areas that will support primarily passenger vehicle traffic and occasional light maintenance vehicle traffic, while the heavy duty section will be utilized in the driveway entrances and drive aisles where traffic will consist of delivery, trash removal, maintenance vehicle traffic, fire truck traffic, and passenger vehicle traffic. The pavement design for the light and heavy duty sections will be based on maximum traffic loads of 12,000 and 100,000 equivalent single axle loads (ESALs), respectively, initial serviceability of 4.2, terminal serviceability of 2.2, a reliability of 90 percent, a standard deviation of 0.45 for flexible pavements, and a design life of 20 years. The design analyses for pavements

have been based on methodology from the American Association of State Highway and Transportation Officials' (AASHTO) *Guide of Design of Pavement Structures*, 1993 and guidelines established for SUPERPAVE as outlined in the Pavement Design Guide from the Pennsylvania Asphalt Pavement Association. The following pavement design assumes a stable and yielding subgrade at the time of the subbase and asphalt placement.

We have estimated the subgrade soils will be prepared to achieve a minimum CBR of 3. Making this assumption, it is possible to use typical pavement sections consisting of the following:

Table 5.2.2.1: Asphalt Pavement Sections

Recommended Minimum Thickness (Inches)		
Pavement Materials	Light Duty	Heavy Duty
Asphalt Surface Course (SUPERPAVE 9.5mm)	1.5	1.5
Asphaltic Base Course (SUPERPAVE 19mm Base Course)	2.5	2.5
Asphaltic Base Course (SUPERPAVE 25mm Base Course)	-	3.0
Crushed Stone Base	6.0	12.0

5.2.3 Rigid Pavement

Rigid concrete pavement may be used instead of flexible pavement. The typical rigid pavement sections are listed below. Rigid pavement is recommended to be used where trash dumpsters or large trucks are to be parked on the pavement. This should provide better distribution of surface loads to the sub grade without causing surficial deformation.

Table 5.2.3.1: Concrete Pavement Sections

Rigid Pavement Recommended Thickness (Inches)	
Pavement Materials	Driveways/Truck Lanes
Reinforcement	WWF6x6-W6xW6
Dowels at Joints	7/8" diameter x 18" long @ 12" c-c
Portland Cement Concrete f'c=4000 psi	7.0
Crushed Stone Base	6.0

The above sections represent minimum thickness representative of typical local construction practices and periodic maintenance should be anticipated. Pavement may be placed after the subgrade has been properly compacted, fine graded and proofrolled as recommended earlier in this report. It should be noted that undercutting of some areas of soft soils or existing fill may be necessary, based on the results of the test pits. Actual pavement section thickness and joint spacing, if applicable, should be determined by the design civil engineer or geotechnical engineer based on traffic loads, volume, and the owner's design life requirements.

An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Sealing of saw cut and construction joints will be critical to the long term success of the pavement. Failure to do so or to maintain this seal can result in failure of the concrete joint. Furthermore, good drainage should reduce the possibility of the subgrade materials becoming saturated over a long period of time. We would be pleased to be of further assistance to you in the design of the project pavements by providing additional recommendations during construction of the project.

Weather Restrictions: In this region, asphalt plants may close during the months of December, January, and/or February if particularly cold weather conditions prevail. However, this can change based on year to year temperature fluctuations. Daily temperatures from December to February will often stay below 40°F, limiting the days that asphalt placement can occur. Asphalt and concrete should not be placed on exposed subbase that has been exposed to freezing temperatures until it is confirmed that no frost is in the subbase or subgrade. Failure to do so can result in unacceptable frost heaving and settlement.

5.3 STORMWATER MANAGEMENT AREAS

5.3.1 Stormwater Management Facilities

General: The plans provided depict the locations of proposed below-grade stormwater management facilities located in front of the parking lot.

5.3.1.a Infiltration Characteristics

As presented in Section 3.1.2 and 3.5, the testing at the project site recorded variable rates of infiltration and consistent subsurface conditions. The infiltration rates collected varied from 0.00 in/hr to 0.51 in/hr. Groundwater was encountered at B-10 at 7 feet which is within 2 feet of the designed infiltration test depth of 6 feet. The infiltration test was then conducted at 5 feet below existing grade.

Based on the results of the infiltration testing, infiltration characteristics are very limited to negligible at the tested elevations. ECS recommends that stormwater management for this property consist of volume and rate control combined with water quality measures using BMP facilities. Some minor amounts of infiltration may occur in the natural soils; however, for design purposes we recommend that stormwater management facilities consist of BMP areas for water quality with underdrains to convey the water offsite.

It is recommended that verification of the subgrade conditions at the time of construction be conducted by an authorized ECS representative. ECS recommends that specific construction notes appear on the plans requiring full-time observation of the excavation of the basins by the authorized ECS representative to verify suitable conditions are present. ECS can assist in developing these notes once plans become more final.

5.3.1.b Embankment/Outlet Structures/Slopes

Embankment construction or cut slopes to facilitate basin construction should incorporate side slopes of 3(H):1(V) or flatter. If steeper slopes are necessary, ECS should be contacted to review the proposed slope geometry.

Fill materials should be placed to a minimum of 95% of the maximum dry density of the material, as determined by the Standard Proctor method (ASTM D698). The moisture content of the materials should be within +/- 3% of the optimum.

5.3.1.c Temporary Sediment Basin Fill Embankments

Soils used in temporary sediment basin fill embankments should satisfy the requirements for fill discussed above and should be placed and compacted to the specification requirements for Structural Fill. Care should be taken not to track heavy equipment over the basin bottom during construction.

5.3.2 Stormwater Management Recommendations

General principles that are recommended to be used in the layout and design of stormwater facilities for this project are as follows:

- Use existing drainage patterns
- Avoid concentrating water
- Reduce stormwater runoff volume and velocity
- Use of shallow, broad basins/BMP areas
- Minimize loading ratios as much as possible
- Maintain the stormwater facilities post construction.
- Limit the depth of standing water in the facilities to less than approximately 2.0 feet.

Water quality measures typically consist of basins with amended soils and underdrains. ECS recommends that a layer of amended soils having a minimum thickness of 1 foot be utilized in basin/BMP areas. We recommend amended soils be used having characteristics generally conforming to the following table.

Table 5.3.2.1 Recommended Amended Soil Blend

Permissible Soil Types for Amended Soil, based on UDSA Classification	Ranges of USDA Particle Size Percentages						Typical Infiltration Rates for Permissible Soil Types (in/hr)*	
	Sand		Silt		Clay		Min	Max
	Min	Max	Min	Max	Min	Max		
Sand, Loamy Sand, Sandy Loam, Loam	50	100	0	50	0	20	0.5	6.0

Contract documents and plan rates should require in place infiltration testing of the amended soils to verify proper performance of the facilities. ECS recommends that a minimum of two (2)

tests be performed on the amended soils and laboratory gradation testing performed to verify the suitability of the soils as an infiltration medium.

It is recommended that field verification of the subgrade conditions should be verified by the authorized ECS representative. ECS recommends that specific construction notes appear on the plans requiring full-time observation of the excavation of the basins by the authorized ECS representative to verify suitable conditions are present.

For BMP basin areas that are used as sediment basins during construction, the basin should not be utilized as a BMP facility until stabilization of contributing areas has been completed. Accumulated sediments in the basin area(s) should also be removed.

5.3.3 Stormwater Management Facilities - Design Notes

It has been our experience that construction of basins may encounter conditions that were not anticipated as a result of the subsurface exploration. As a result, we have developed the following sequence of items for addressing construction related difficulties or discrepancies with the design assumptions. We recommend that these recommendations be included in the stormwater management feature construction notes on the plans.

A) If redoximorphic features (soil mottling and coloration patterns formed by the reduction of iron and/or manganese from saturated conditions in the soil) are encountered:
   - A qualified professional should determine if the features observed are associated with a historic condition (associated with fill, previous site condition, or natural coloration) or are associated with conditions that could presently occur (seasonal variations in the water table).
   - Evaluate the elevation of the features relative to the proposed design elevation of the SWM feature and determine if the size and elevation of the SWM feature can be adjusted to alleviate the conflict.
   - Retain the Geotechnical Engineer and Civil Engineer to evaluate alternate design concepts. Alternate designs proposed by the Professional should be sealed and submitted to the Township for approval.

6.0 SITE CONSTRUCTION RECOMMENDATIONS

6.1 SUBGRADE PREPARATION

6.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping all asphalt, gravel, unsuitable existing fill, and any other soft or unsuitable materials. Borings identified that surficial material consisted of topsoil up to 6 inches in thickness and asphalt covers portions of the site. The suitability of any fill materials should be evaluated at the time of site preparation for its suitability for support of the floor slab and pavement areas. Select undercutting of soft, wet, or otherwise deleterious materials should be anticipated. ECS should be called on to verify that unsuitable surficial and existing fill materials have been completely removed prior to the placement of Structural Fill or construction of structures. As previously discussed in Section 5.1.2, we recommend that the earthwork incorporate undercutting of approximately 2 feet within the building pad as part of the site preparation due to the anticipated presence of soft and wet subgrade materials.

6.1.2 Proofrolling

After removing all unsuitable surface materials, cutting to the proposed grade, and prior to the placement of any structural fill or other construction materials, the exposed subgrade should be examined by the Geotechnical Engineer or authorized representative. The exposed subgrade should be thoroughly proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. fully loaded tandem-axle dump truck) under the observation of the Geotechnical Engineer or authorized representative. This procedure is intended to assist in identifying localized yielding materials. In the event that unstable or “pumping” subgrade is identified by the proofrolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials. Methods of repair of unstable subgrade, such as undercutting, use of geogrid, moisture conditioning, or chemical stabilization, should be discussed with the Geotechnical Engineer to determine the appropriate procedure with regard to the existing conditions causing the instability. A test pit(s) may be excavated to explore the shallow subsurface materials in the area of the instability to help in determined the cause of the observed unstable materials and to assist in the evaluation of the appropriate remedial action to stabilize the subgrade. It is worth noting that some localized areas of soft/loose material were observed in the soil profile and when encountered should be removed and replaced with suitable material.

6.1.3 Subgrade Stabilization

Subgrade Benching: Fill should not be placed on ground with a slope steeper than 5H:1V, unless the fill is confined by an opposing slope, such as in a ravine. Otherwise, where steeper slopes exist, the ground should be benched so as to allow for fill placement on a horizontal surface.

Subgrade Compaction: Upon completion of subgrade documentation, the exposed subgrade within the 10-foot expanded building and 5-foot expanded pavement and embankment limits should be moisture conditioned to within -1 and +3 % of the soil’s optimum moisture content and be compacted with suitable equipment (minimum 10-ton roller) to a depth of 10 inches. Subgrade compaction within the expanded building, pavement, and embankment limits should be to a dry

density of at least 95% of the Standard Proctor maximum dry density (ASTM D698). ECS should be called on to document that proper subgrade compaction has been achieved.

Subgrade Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits for buildings, pavements, fills, and slopes, etc. Field density testing of subgrades will be performed at frequencies in Table 6.3.2.1.

Subgrade Stabilization: Is some areas, particularly low-lying, wet areas of the site, undercutting of excessively soft materials may be considered inefficient. In such areas the use of a reinforcing geotextile or geogrid might be employed, under the advisement of ECS. Suitable stabilization materials may include medium duty woven geotextile fabrics or geogrids. The suitability and employment of reinforcing or stabilization products should be determined in the field by ECS personnel, in accordance with project specifications.

6.2 EARTHWORK OPERATIONS

6.2.1 Structural Fill Materials

Product Submittals: Prior to placement of Structural Fill, representative bulk samples (about 50 pounds) of on-site and off-site borrow should be submitted to ECS for laboratory testing, which will include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications.

Satisfactory Structural Fill Materials: Materials satisfactory for use as Structural Fill should consist of inorganic soils classified as CL, ML, SM, SC, SW, SP, GW, GP, GM and GC, or a combination of these group symbols, per ASTM D 2487. The materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest dimension. Open graded materials, such as Gravels (GW and GP), which contain void space in their mass should not be used in structural fills unless properly encapsulated with filter fabric. Suitable Structural Fill material should have the index properties shown in Table 6.2.

Table 6.3.1.1 Structural Fill Index Properties

Location with Respect to Final Grade	LL	PI
Building Areas, upper 4 feet	40 max	20 max
Pavement Areas, upper 2 feet	40 max	20 max

Unsatisfactory Materials: Unsatisfactory fill materials include materials which do not satisfy the requirements for suitable materials, as well as topsoil and organic materials (OH, OL), elastic Silt (MH), and high plasticity Clay (CH).

On-Site Borrow Suitability:
The on-site soils are generally not expected to be suitable for reuse as structural fill. The soils are moisture sensitive and will contain elevated moisture contents. In seasons of dry weather. Portions of the on-site materials may be able to be dried and reused as fill.

6.2.2 Compaction

Structural Fill Compaction: Structural Fill within the expanded building and pavement limits should be placed in maximum 8-inch loose lifts, moisture conditioned as necessary to within -1 and +3 % of the soil's optimum moisture content, and be compacted with suitable equipment to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D698). ECS should be called on to document that proper fill compaction has been achieved.

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. All filling operations should be observed on a full-time basis by a qualified representative of the construction testing laboratory to determine that the minimum compaction requirements are being achieved. Field density testing of fills will be performed at the frequencies shown in Table 6.3, but not less than 1 test per lift.

Table 6.3.2.1 Frequency of Compaction Tests in Fill Areas

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft. per lift
Pavement Areas	1 test per 10,000 sq. ft. per lift
Utility Trenches	1 test per 200 linear ft. per lift
Outparcels/SWM Facilities	1 test per 5,000 sq. ft. per lift
All Other Non-Critical Areas	1 test per 10,000 sq. ft. per lift

Compaction Equipment: Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials. Sheepsfoot compaction equipment should be suitable for the fine-grained soils (Clays and Silts). A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) as well as for sealing compacted surfaces.

Fill Placement Considerations: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

At the end of each work day, all fill areas should be graded to facilitate drainage of any precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, earthwork should be performed during the warmer, drier times of the year, if practical. Proper drainage should be maintained during the earthwork phases of construction to prevent ponding of water which has a tendency to degrade subgrade soils. Alternatively, if these soils cannot be stabilized by conventional methods as previously discussed, additional

modifications to the subgrade soils such as lime or cement stabilization may be utilized to adjust the moisture content. If lime or cement are utilized to control moisture contents and/or for stabilization, Quick Lime, Calciment® or regular Type 1 cement can be used. The construction testing laboratory should evaluate proposed lime or cement soil modification procedures, such as quantity of additive and mixing and curing procedures, before implementation. The contractor should be required to minimize dusting or implement dust control measures, as required.

Where fill materials will be placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material. Fill material should be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 inches to 4 inches may be required to achieve specified degrees of compaction.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. We do not anticipate significant problems in controlling moisture within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain. The control of moisture content of higher plasticity soils is difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

6.3 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick “mud mat” of “lean” concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: Most of the soils at the foundation bearing elevation are anticipated to be fine-grained soils with elevated moisture contents. Foundation subgrades should be undercut and widened 2 feet with subgrades destabilized with compacted 2A aggregate as outlines in section 5.1.1. It will be important to have the Geotechnical Engineer of record, or his qualified representative, observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated. If soft or unsuitable soils, such as existing fill, are observed at the footing bearing elevations, the unsuitable soils should be undercut a minimum further feet and removed. Any undercut should be backfilled with compacted 2A stone to restore the footing subgrade elevation.

Slab Subgrade Verification: A representative of ECS should be called on to observe exposed subgrades within the expanded building limits prior to Structural Fill Placement to assure that adequate subgrade preparation has been achieved. A proofrolling using a drum roller or loaded dump truck should be performed in their presence at that time. Once subgrades have been prepared to the satisfaction of ECS, subgrades should be properly compacted and new Structural Fill can be placed. Existing subgrades to a depth of at least 10 inches and all Structural Fill should be moisture conditioned to within -1/+3 percentage points of optimum moisture content then be compacted to the required density. If there will be a significant time lag between the site grading work and final grading of concrete slab areas prior to the placement of the subbase stone and

concrete, a representative of ECS should be called on to verify the condition of the prepared subgrade. Prior to final slab construction, the subgrade may require scarification, moisture conditioning, and re-compaction to restore stable conditions.

6.4 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrade should be observed and, if suspect, probed for stability by ECS to evaluate the suitability of the materials encountered. Any loose or unsuitable materials encountered at the utility pipe subgrade elevation should be removed and replaced with suitable compacted Structural Fill or pipe bedding material.

Utility Constructability: The groundwater elevation at the project site is approximately 6 feet below existing grade. A combination of shallow groundwater and heaving sands present at the site could cause construction issues and lead to time and cost overruns. Because of this, attempts should be made to keep all utility excavations above the groundwater table. Wet soils will also contribute to exaction sidewall instability; therefore, excavation protection may be required.

Utility Backfilling: The granular bedding material should be at least 4 inches thick, but not less than that specified by the project drawings and specifications. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for Structural Fill given in this report. Compacted backfill should be free of topsoil, roots, ice, or any other material designated by ECS as unsuitable. The backfill should be moisture conditioned, placed, and compacted in accordance with the recommendations of this report.

Utility Excavation Dewatering: It is possible that perched water may be encountered by utility excavations which extend below existing grades. It is expected that removal of perched water which seeps into excavations could be accomplished by pumping from sumps excavated in the trench bottom and which are backfilled with AASHTO No. 57 Stone or open graded bedding material. Should water conditions beyond the capability of sump pumping be encountered, the contractor should submit a Dewatering Plan in accordance with project specifications.

Excavation Safety: All excavations and slopes should be made and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing and constructing stable, temporary excavations and slopes and should shore, slope, or bench the sides of the excavations and slopes as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.5 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction.

Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

Excavation Safety: Cuts or excavations associated with utility excavations may require forming or bracing, slope flattening, or other physical measures to control sloughing and/or prevent slope failures. Contractors should be familiar with applicable OSHA codes to ensure that adequate protection of the excavations and trench walls is provided.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. All erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

7.0 CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design, construction, and stormwater management design aspects of the project.

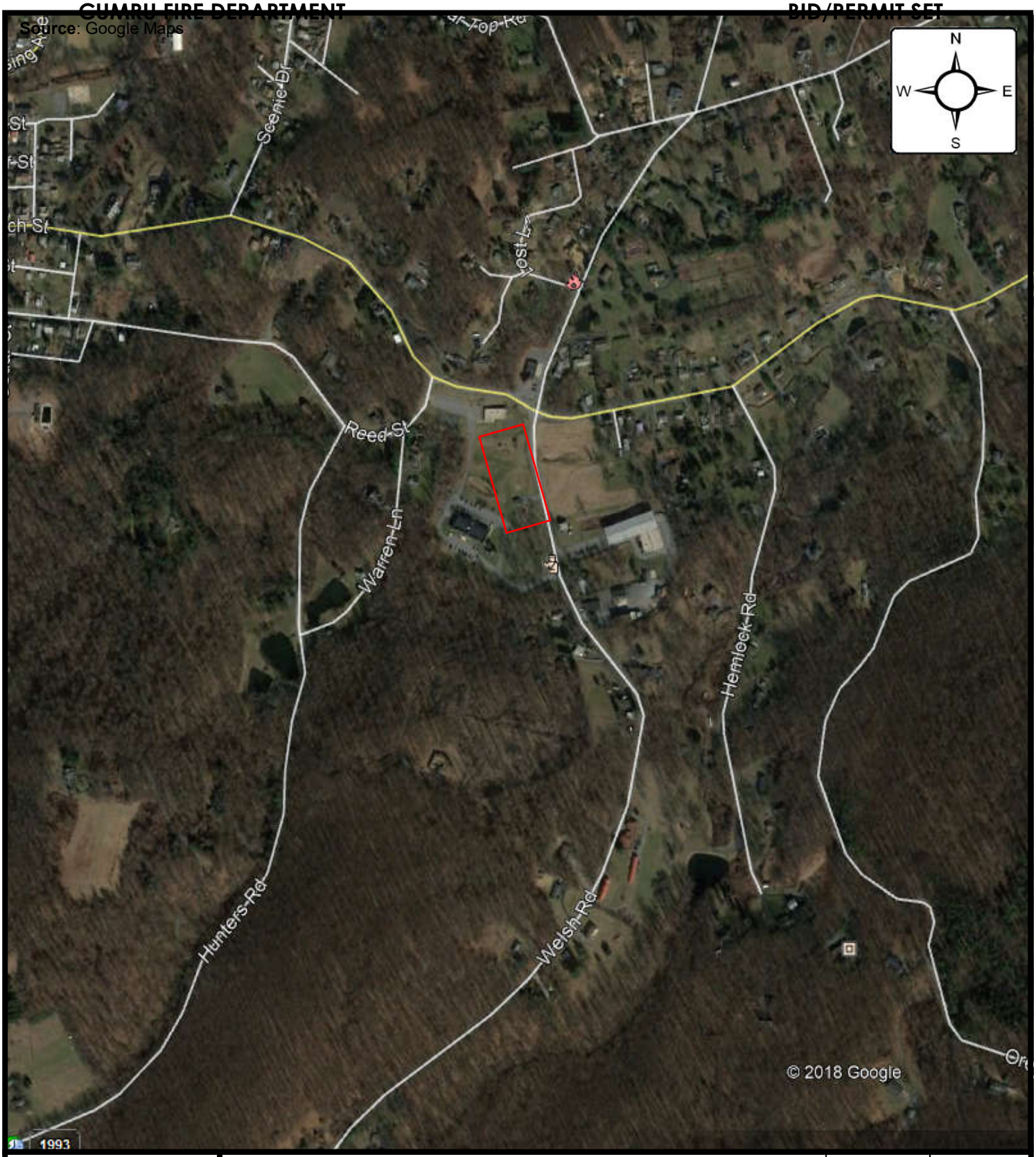
The description of the proposed project is based on information provided to ECS by Manns Woodward Studios. If any of this information is inaccurate, either due to our interpretation of the documents provided or if the site's design changed, ECS should be contacted immediately to review the report in light of the changes and provide additional or alternate recommendations as required to reflect the proposed construction.

We recommend that ECS be allowed to review project plans and specifications, so we may evaluate consistency of those plans/specifications with our geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendation. We recommend that the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these critical phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

Site Location Map
Geologic Map
Boring/Test Pit Location Map
Soil Survey Map

Source: Google Maps

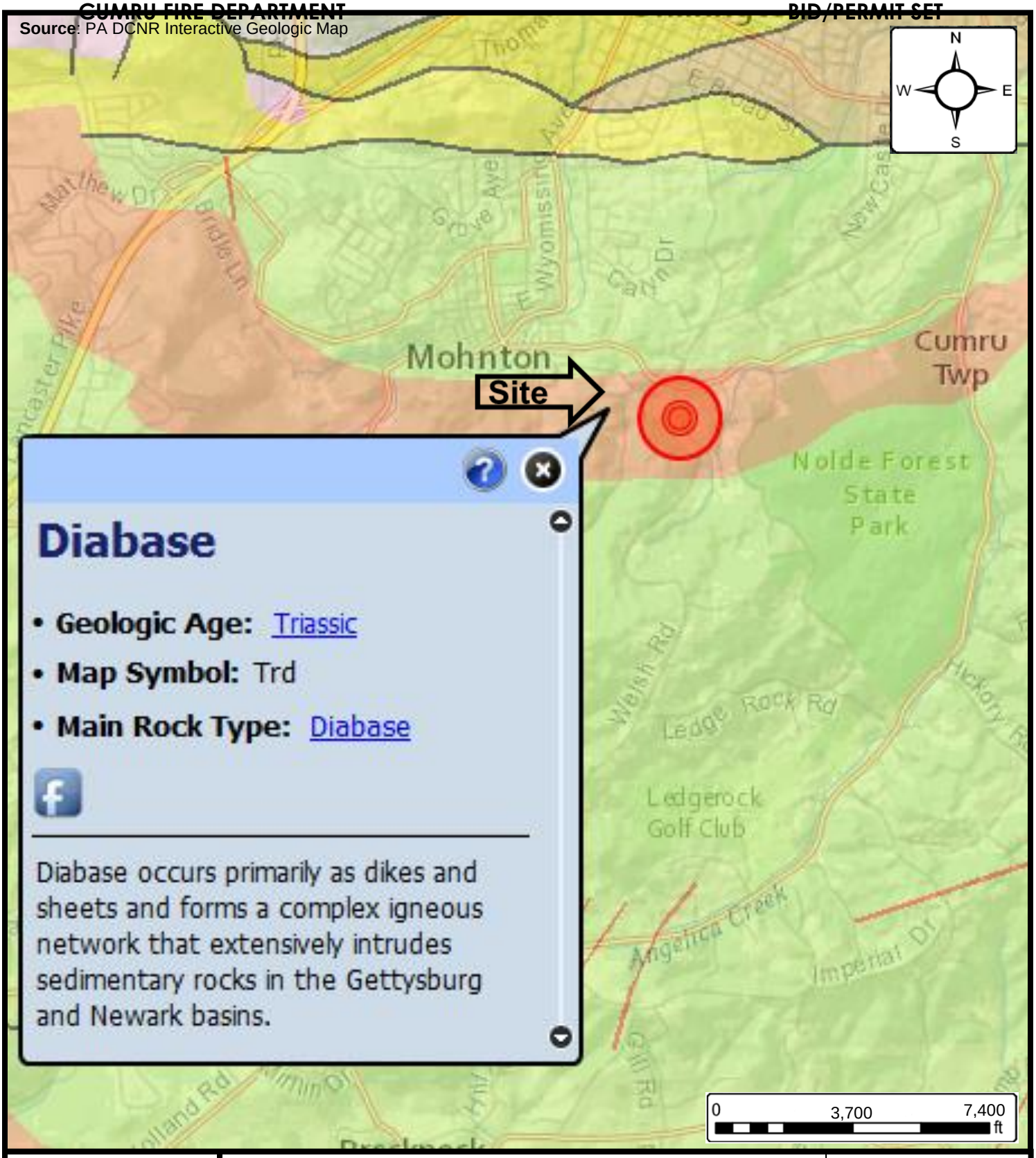


SITE LOCATION MAP
Cumru Township Fire Station

Manns Woodward Studios
Welsh Rd, Mohnton, PA

REVIEWER	DRAFTER
DGR	NCH
SCALE	NTS
PROJECT NO.	18.4591-A
DATE	12/7/2018
SOURCE	Google Earth

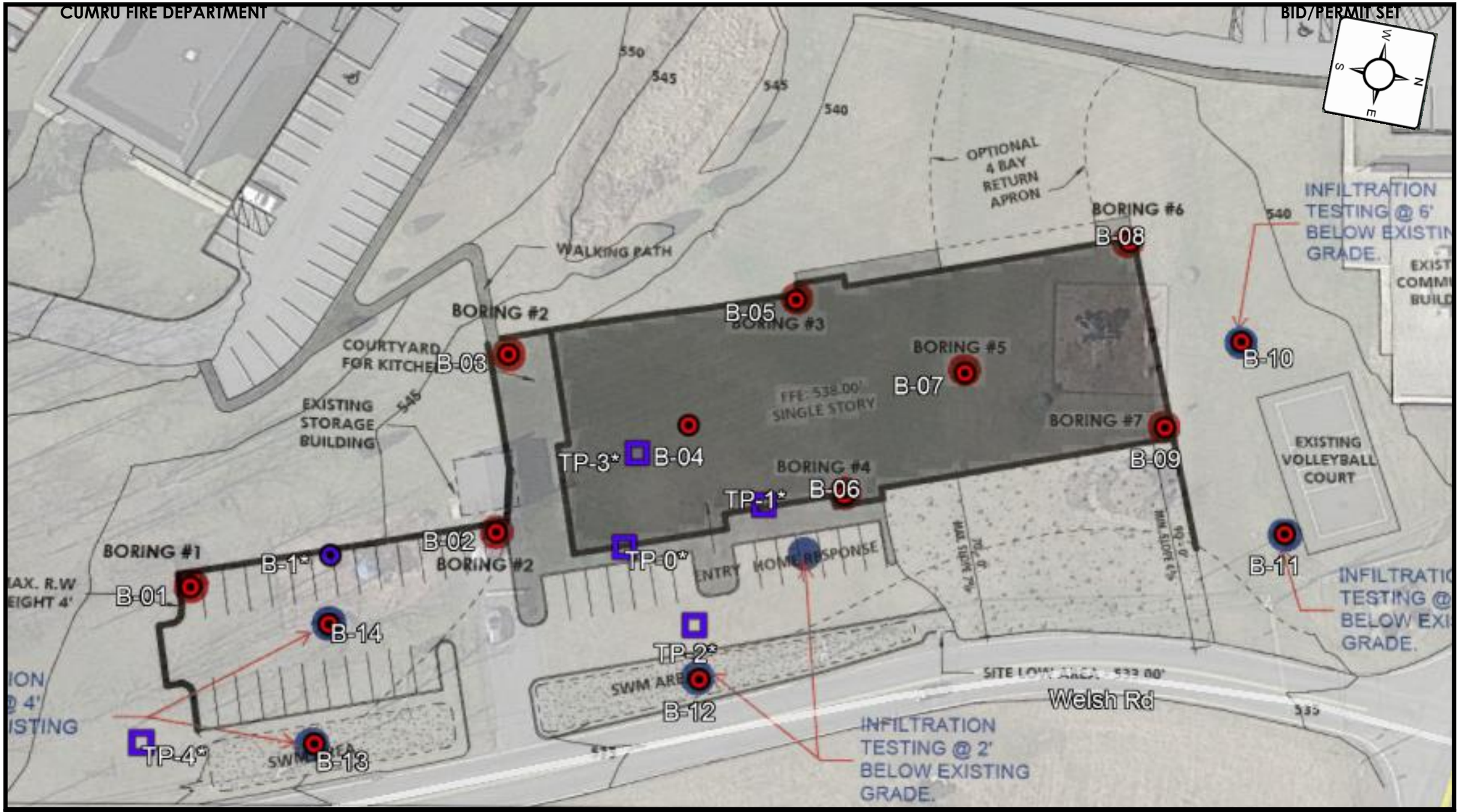
Source: PA DCNR Interactive Geologic Map



REGIONAL BEDROCK GEOLOGY MAP
Cumru Township Fire Station

Manns Woodward Studios
Welsh Rd., Mohnton, PA

ENGINEER	JMC
SCALE	1"= 3,700'
PROJECT NO.	18.4591
SHEET	1 of 1
DATE	7/23/2018



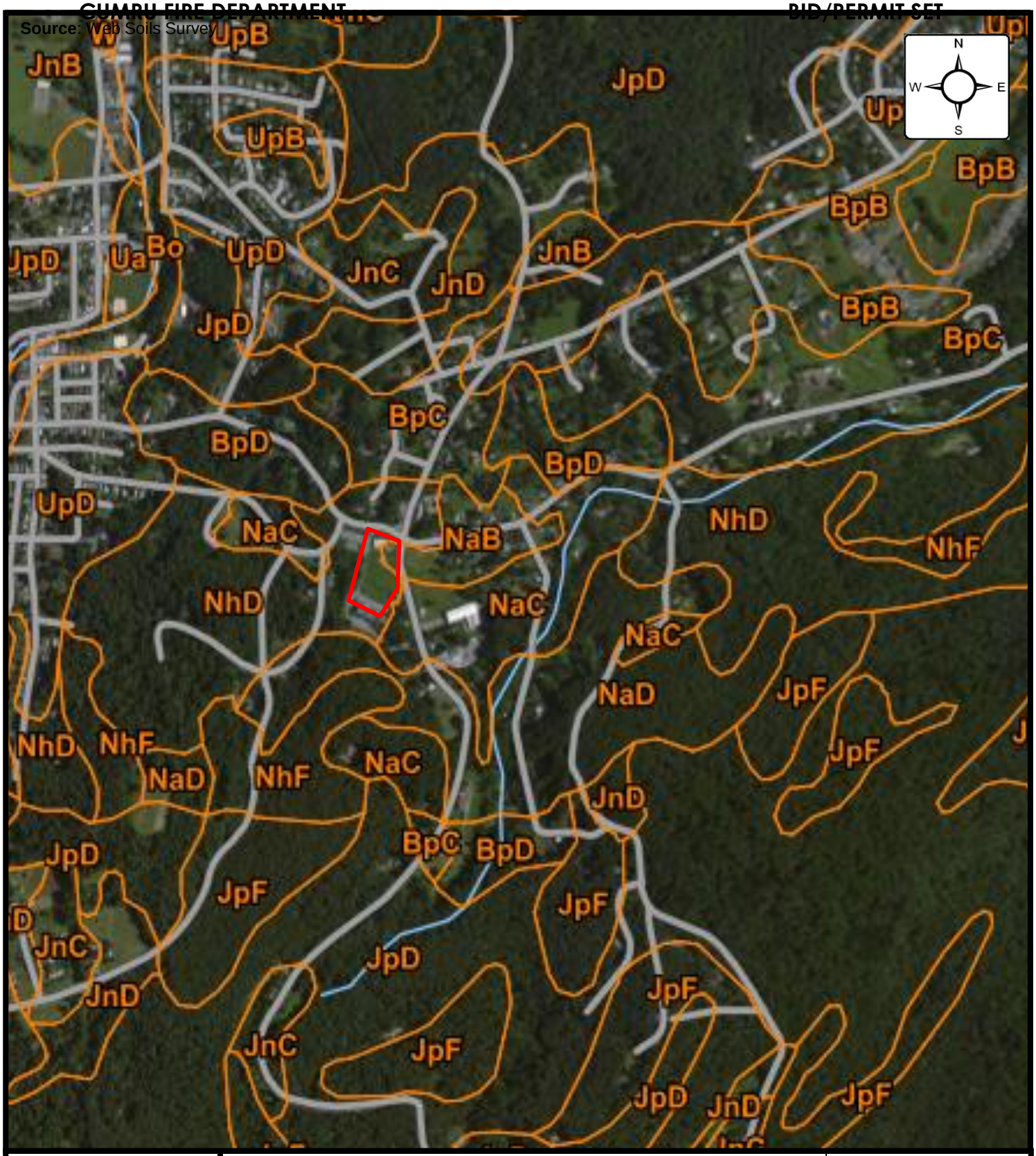
GEOTECHNICAL REPORT

BORING / TEST PIT LOCATION MAP
Cumru Township Fire Station

Manns Woodward Studios
Welsh Rd, Mohnton, PA

REVIEWER DGR	DRAFTER VAS
SCALE	NTS
PROJECT NO.	18:4591-A
DATE	01/07/2018
SOURCE	Google Earth

Source: Web Soils Survey



SOIL SURVEY MAP
Cumru Township Fire Station

Manns Woodward Studios
Welsh Rd, Mohnton, PA

ENGINEER	JMC
SCALE	NTS
PROJECT NO.	18.4591
SHEET	1 of 1
DATE	7/23/2018

Boring Logs
Test Pit Logs
Subsurface Profile
Footing Subgrade Repair Detail
Infiltration Test Results
Boring Log Reference Notes

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-01	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

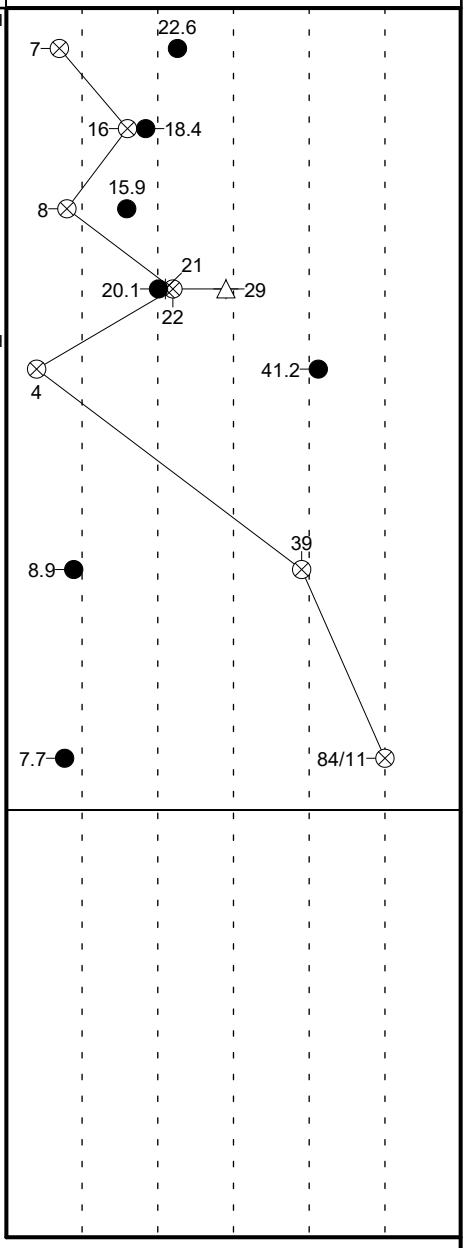
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 548

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	18	Topsoil Thickness [4.00"] (CL FILL) FILL, LEAN CLAY WITH SAND, brown, moist, firm			WOH 3 4
	S-2	SS	24	22	(CL FILL) FILL, SANDY LEAN CLAY, brown, moist, very stiff		545	6 6 7 9 10
5	S-3	SS	24	24	(CL) LEAN CLAY WITH SAND, trace gravel, brown, moist, firm			2 3 5 8
	S-4	SS	24	10	(CL) SANDY LEAN CLAY, brown, moist, firm to very stiff			7 9 13 13
	S-5	SS	24	21			540	WOH 2 2 4
10								
	S-6	SS	24	16	(SP) SAND, brown and gray, moist, dense to very dense	▽	535	1 11 28 31
15								
	S-7	SS	17	14			530	18 34 50/5
20					END OF BORING @ 20'			
							525	
25								
							520	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 13.0' WS ☐ WD ☒	BORING STARTED 12/06/18	CAVE IN DEPTH 14.0'
▽ WL(SHW) ▼ WL(ACR)	BORING COMPLETED 12/06/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 39**

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-02	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

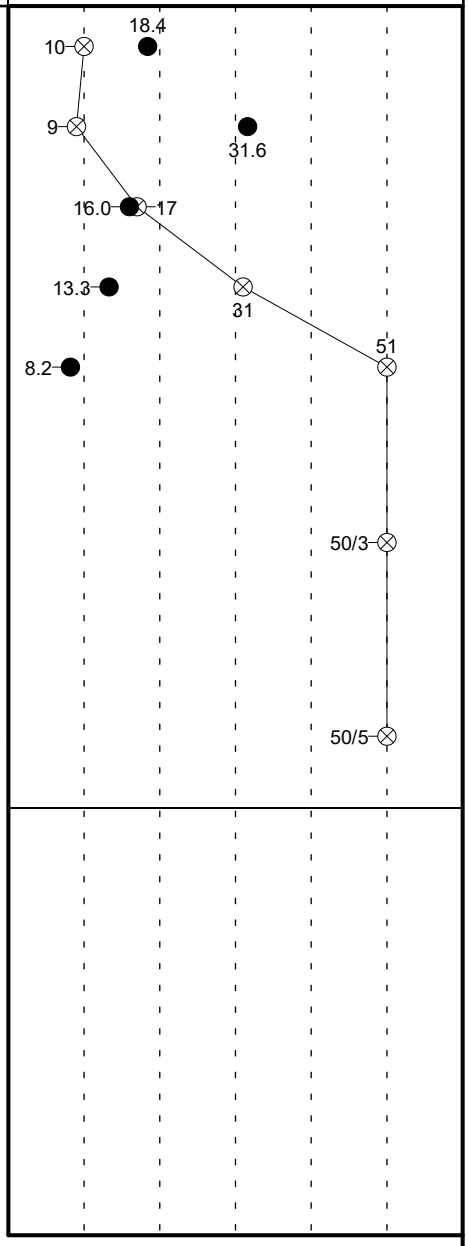
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 539

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [5.00"]			
	S-1	SS	24	20	(CL FILL) FILL, LEAN CLAY WITH SAND, trace gravel, brown and gray, moist, stiff			1 5 5
	S-2	SS	24	22	(CL FILL) FILL, LEAN CLAY, trace sand, brown and gray, moist, stiff			5 4 4
							535	
5	S-3	SS	24	24	(CL FILL) FILL, LEAN CLAY WITH SAND, brown, moist, very stiff			4 5 6
	S-4	SS	24	24	(SP) SAND, trace clay, brown and tan, moist, very dense			4 7 10
	S-5	SS	24	20	(SP) SAND, brown and gray, moist to wet, dense		530	12 11 15
10								16 14 13
	S-6	SS	9	9			525	22 29 32 33 50/3
15								
	S-7	SS	5	5			520	50/5
20					END OF BORING @ 20'			
							515	
25								
							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 13.0' WS ☐ WD ☒	BORING STARTED 12/06/18	CAVE IN DEPTH 9.0'
WL(SHW) WL(ACR) 9.0'	BORING COMPLETED 12/06/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 40**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-03	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

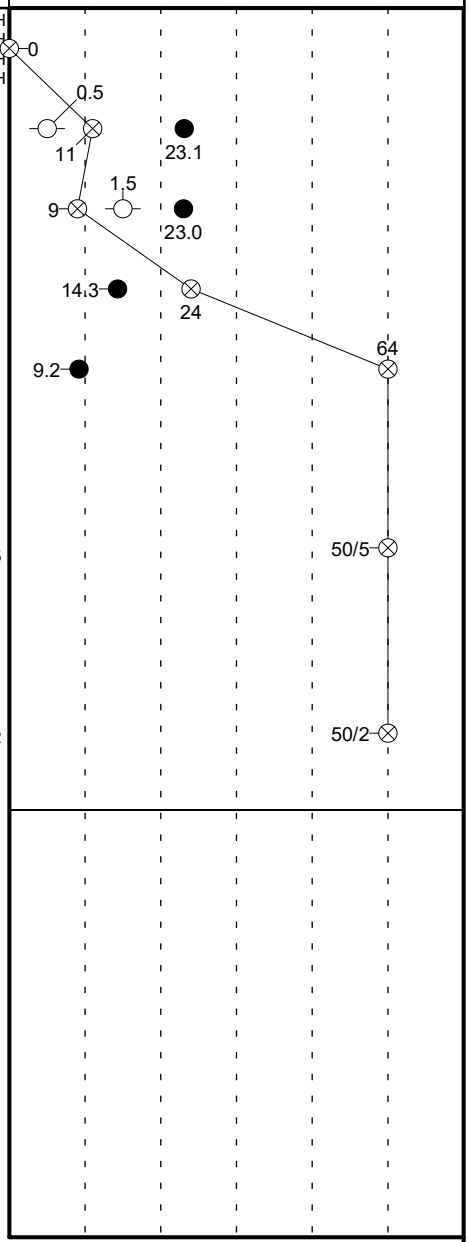
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 540

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	0	(NO RECOVERY)		540	WOH WOH WOH WOH
	S-2	SS	24	24	(CL FILL) FILL, LEAN CLAY WITH SAND, brown and red, wet, firm			3 5 6 8
5	S-3	SS	24	18	(CL FILL) FILL, LEAN CLAY, trace sand, brown and tan, wet, stiff		535	4 4 5 7
	S-4	SS	24	24	(SP FILL) FILL, SAND, trace clay, brown and tan, moist, medium dense			9 10 14 20
	S-5	SS	24	24	(SP) SAND, trace gravel, brown, red and tan, moist to dry, very dense			27 35 29 46
10							530	
	S-6	SS	11	11		▽		24 50/5
15							525	
	S-7	SS	2	2	(SP) SAND WITH GRAVEL, trace clay, brown, wet, very dense			50/2
20					END OF BORING @ 20'		520	
25							515	
30							510	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 13.0' WS ☐ WD ☒	BORING STARTED 12/06/18	CAVE IN DEPTH 11.0'
▽ WL(SHW) ▼ WL(ACR)	BORING COMPLETED 12/06/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-04	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

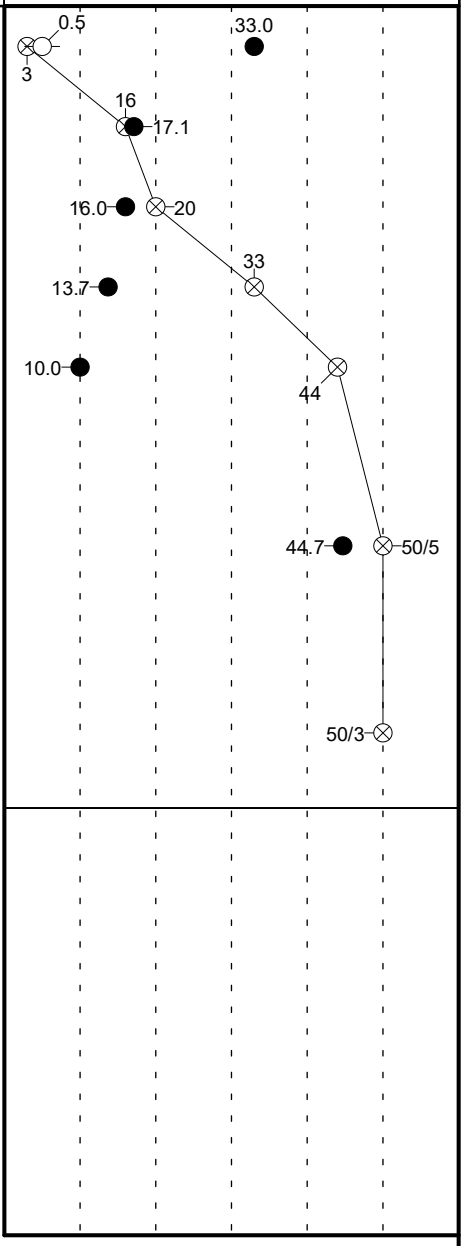
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 539

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4.00"]			WOH
	S-1	SS	24	22	(CL FILL) FILL, LEAN CLAY, gray and orange, moist, soft			WOH
	S-2	SS	24	24	(SP-SC FILL) FILL, SAND WITH CLAY, red, tan, moist, medium dense			3 3 6 8
5	S-3	SS	24	22	(SP FILL) FILL, SAND, trace clay, brown, red, and tan, moist, medium dense to dense		535	8 12 8 9
	S-4	SS	24	24				11 17 12 15
	S-5	SS	24	21	(SP) SAND, brown and tan, moist, dense		530	18 29 22 24
10								20 39
	S-6	SS	11	11	(SP-SC) SAND WITH CLAY, brown and tan, wet, very dense		525	33 50/5
15								
	S-7	SS	3	3	(SP) SAND, brown and black, wet, very dense		520	50/3
20					END OF BORING @ 20'			
							515	
25								
							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 13.0' WS ☐ WD ☒	BORING STARTED 12/05/18	CAVE IN DEPTH 5.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/05/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 42**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-05	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC%

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

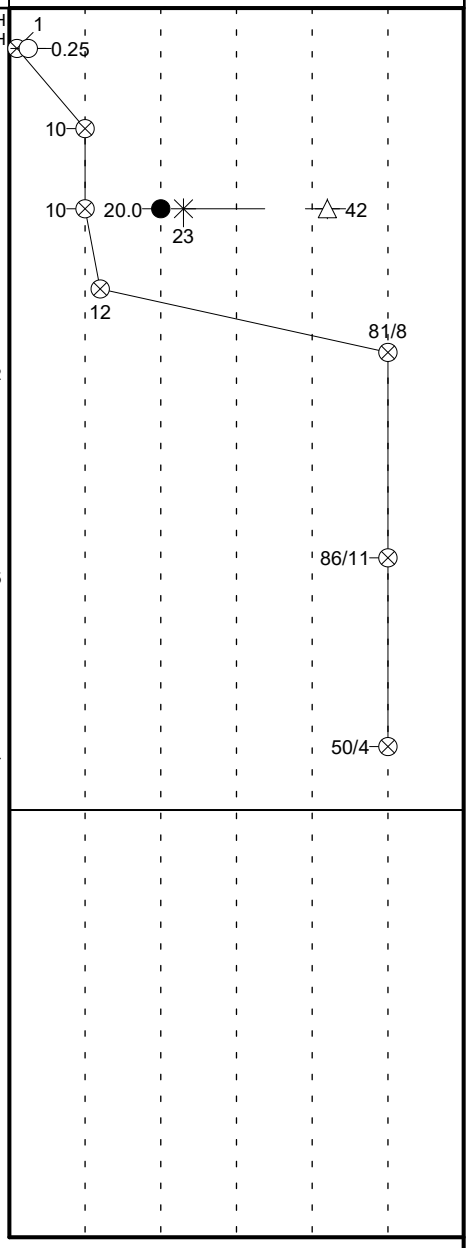
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 539

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	12	Topsoil Thickness [3.00"] (CL) LEAN CLAY, brown and tan, wet, very soft			WOH WOH
	S-2	SS	24	24	(CL) LEAN CLAY, brown and gray, moist to wet, stiff		535	1 1 3 5 5 7
5	S-3	SS	24	20				3 5 5 7
	S-4	SS	24	18				5 5 7 9
	S-5	SS	14	14	(SP) SAND, trace gravel, brown, tan, and gray, moist, very dense		530	8 31 50/2
10								
	S-6	SS	17	17			525	33 36 50/5
15								
	S-7	SS	10	10			520	45 50/4
20					END OF BORING @ 20'			
							515	
25								
							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 0.0' WS ☐ WD ☒	BORING STARTED 12/06/18	CAVE IN DEPTH 9.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/06/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-06	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

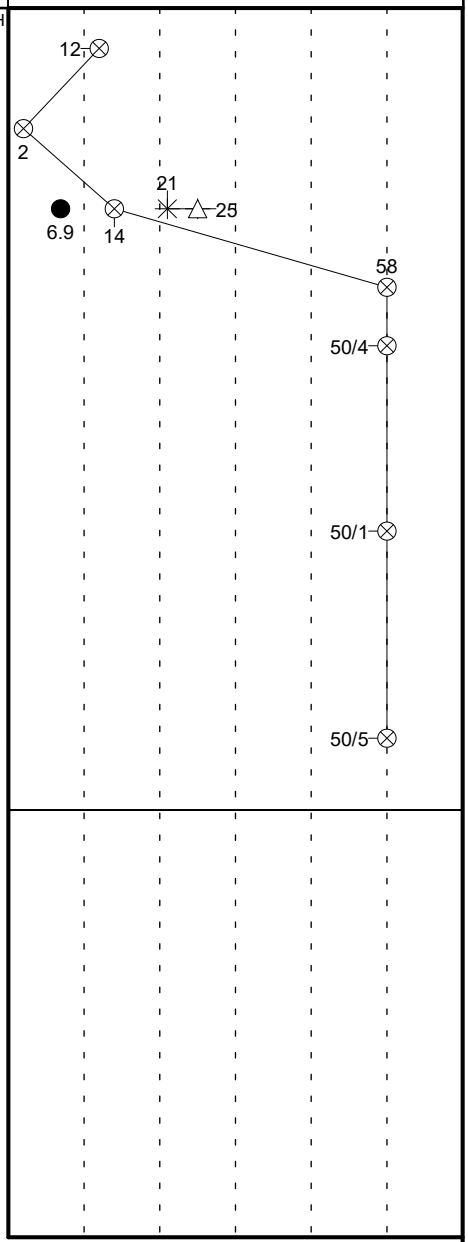
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 536

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [3.00"]			WOH
	S-1	SS	24	8	(CL) LEAN CLAY WITH GRAVEL, trace sand, brown, wet, very soft		535	1 11 10
	S-2	SS	24	14	(CL) LEAN CLAY, trace sand, brown, wet, very soft			2 1 1
5	S-3	SS	24	24	(SC-SM) SILTY CLAYEY SAND, gray and brown, moist, medium dense			1 3 5 9 13
	S-4	SS	23	23	(SP) SAND, contains rock fragments, brown and gray, moist to wet, very dense		530	14 25 33 50/5
	S-5	SS	10	10				32 50/4
10							525	
	S-6	SS	1	1				50/1
15							520	
	S-7	SS	5	5				50/5
20					END OF BORING @ 20'		515	
25							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 6.0' WS ☐ WD ☒	BORING STARTED 12/05/18	CAVE IN DEPTH 4.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/05/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA/Spin Casing

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-07	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - — - REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

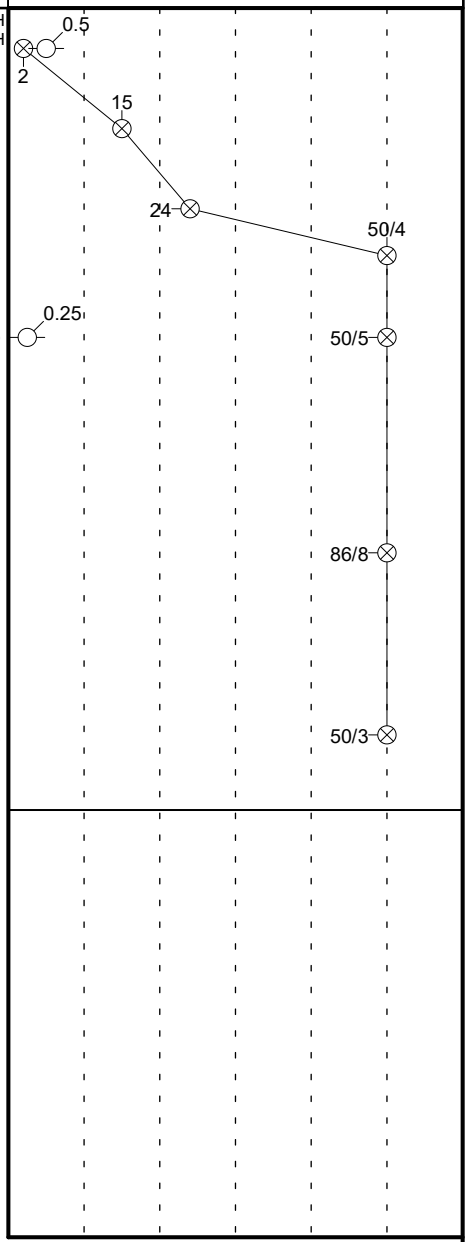
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 537.5

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4.00"]			WOH
	S-1	SS	24	22	(CL FILL) FILL, LEAN CLAY, trace sand, gray and brown, moist, soft			WOH
								2
	S-2	SS	24	24	(SP) SAND, trace clay, brown, moist, medium dense		535	3
								6
								6
								9
								12
5	S-3	SS	24	24	(SP) SAND, trace gravel, contains rock fragments, brown and black, moist, medium dense			8
								8
								16
								31
	S-4	SS	4	4	(CL) LEAN CLAY WITH SAND, contains rock fragments, brown and black, moist to wet, very hard			50/4
							530	
	S-5	SS	5	5				50/5
10								
							525	
	S-6	SS	14	14	(SP) SAND, contains rock fragments, brown and black, moist, very dense			35
								36
								50/2
15							520	
	S-7	SS	3	3				50/3
20					END OF BORING @ 20'			
							515	
25								
							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 13.0' WS ☐ WD ☒	BORING STARTED 12/05/18	CAVE IN DEPTH 5.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/05/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 45**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-08	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

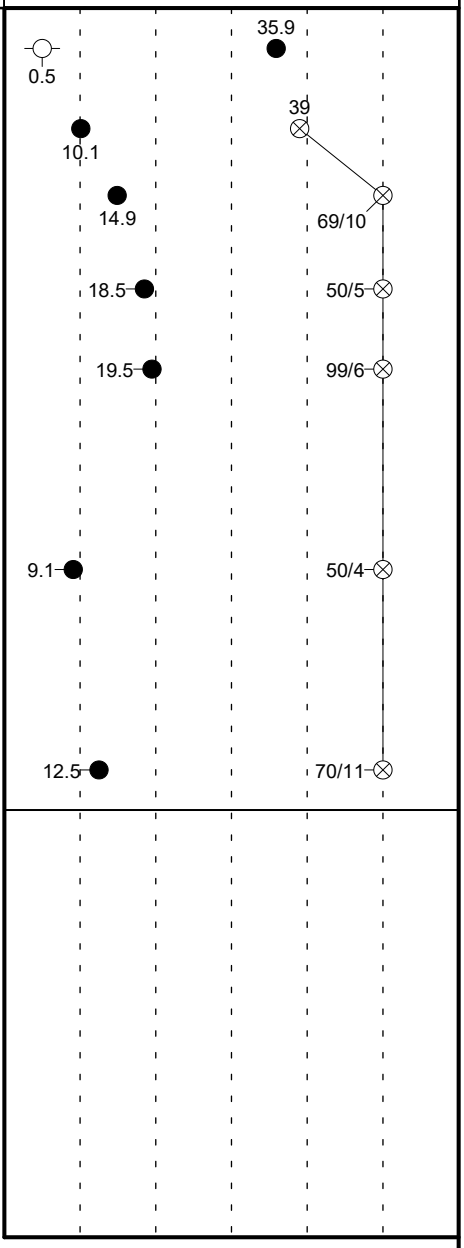
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 539

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	22	Topsoil Thickness [4.00"] (CL) LEAN CLAY, trace sand, brown, gray, moist, firm			WOH 3 4
	S-2	SS	24	24	(SP) SAND, brown, moist, dense		535	5 7 15 24 30
5	S-3	SS	16	16				32 29
	S-4	SS	24	5	(SP) SAND, trace clay, brown, moist, very dense			50/4 50/5
	S-5	SS	24	6			530	49 50/0
10								
	S-6	SS	24	4	(SP) SAND, contains rock fragments, brown, wet, very dense		525	50/4
15								
	S-7	SS	24	11			520	20 50/5
20					END OF BORING @ 20'			
							515	
25								
							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 18.0' WS ☐ WD ☒	BORING STARTED 12/04/18	CAVE IN DEPTH 7.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/04/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-09	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ——

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

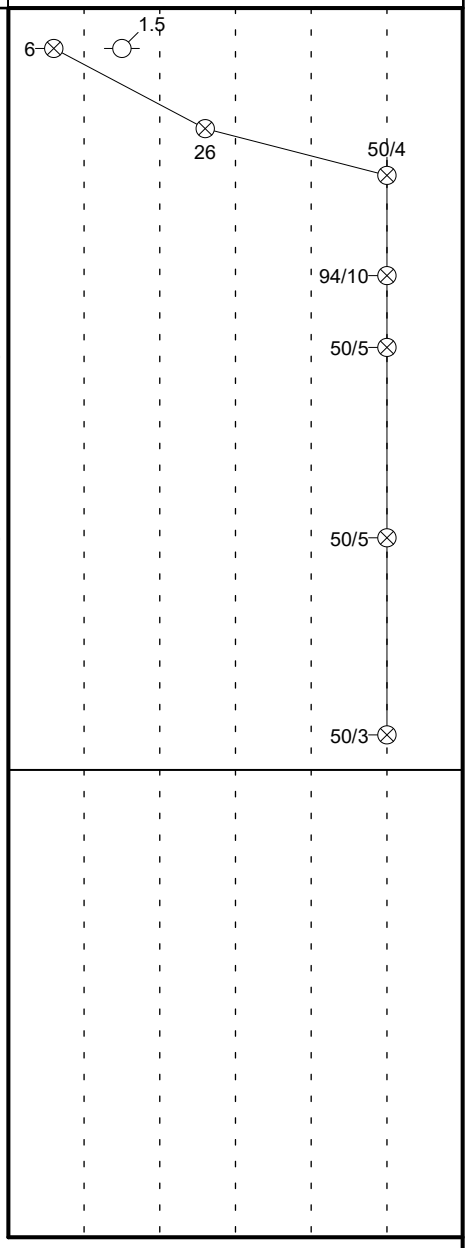
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 536.5

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4.00"]			
	S-1	SS	24	22	(CL) LEAN CLAY, trace sand, gray, moist, stiff		535	1 3 3 5
	S-2	SS	24	24	(SP) SAND, trace clay, brown, moist, medium dense to very dense			6 12 14 18
	S-3	SS	4	4				50/4
5						▽	530	
	S-4	SS	16	16	(SP) SAND, trace gravel, brown, moist, very dense			37 44 50/4
	S-5	SS	11	11	(SP) SAND, brown and tan, wet, very dense			35 50/5
10							525	
	S-6	SS	5	5				50/5
15							520	
	S-7	SS	3	3	(CL) SANDY LEAN CLAY WITH GRAVEL, red, brown,and tan, wet, very hard			50/3
					END OF BORING @ 19'			
20							515	
25							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 6.0' WS ☐ WD ☒	BORING STARTED 12/04/18	CAVE IN DEPTH N/E
▽ WL(SHW) ▼ WL(ACR)	BORING COMPLETED 12/04/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 47**

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-10	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

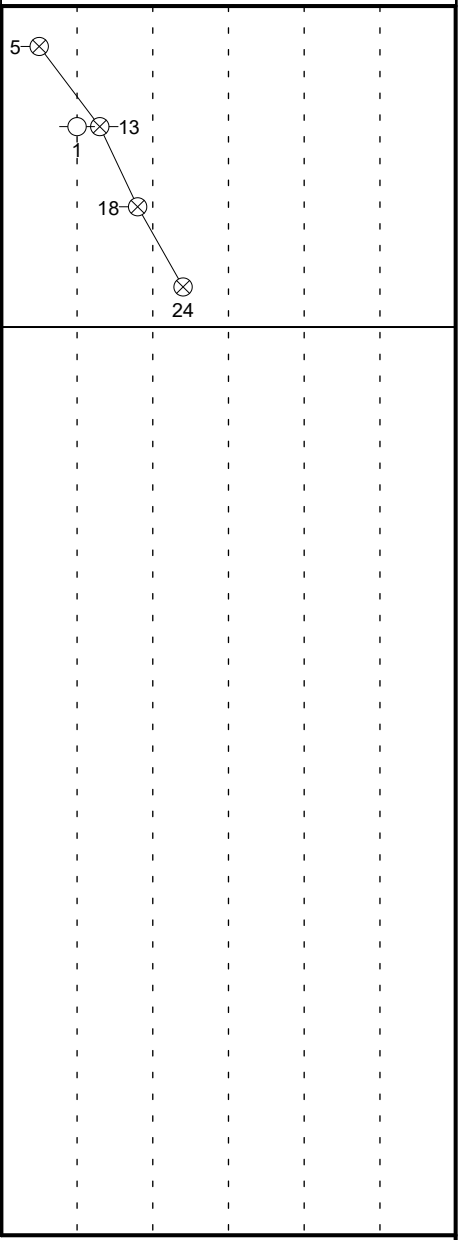
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 538.5

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	12	Topsoil Thickness [3.00"] (ML) SILT WITH SAND, dark brown, moist, loose		538.5	1 2 3 4 4 5 8 8 8 8 10 12 8 8 16 25
	S-2	SS	24	21	(ML) SANDY SILT, gray orange, moist, stiff		535	
5	S-3	SS	24	24	(SP) SAND, trace silt, brown, moist to wet, medium dense			
	S-4	SS	24	16		▽		
					END OF BORING @ 8'		530	
10							525	
15							520	
20							515	
25							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 7.0' WS ☐ WD ☒	BORING STARTED 12/04/18	CAVE IN DEPTH 5.5'
▽ WL(SHW) ▼ WL(ACR)	BORING COMPLETED 12/04/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 48**

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-11	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

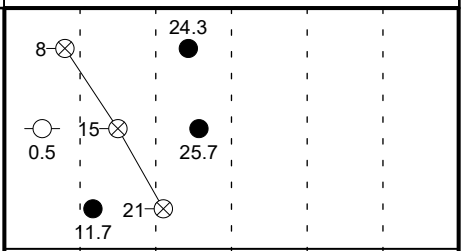
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 536

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	Topsoil Thickness [2.00"] (SP) SAND, trace silt, brown, moist, loose		535	WOH 4 4
	S-2	SS	24	24	(CL) LEAN CLAY WITH SAND, trace silt, gray, moist, firm			4 5 7 8
5	S-3	SS	24	24	(SP) SAND, trace clay, trace gravel, brown, moist, medium dense		530	12 7 9 12 13
					END OF BORING @ 6'			
10							525	
15							520	
20							515	
25							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/E WS ☐ WD ☒	BORING STARTED 12/04/18	CAVE IN DEPTH 1.5'
WL(SHW) WL(ACR)	BORING COMPLETED 12/04/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 49**

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-12	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

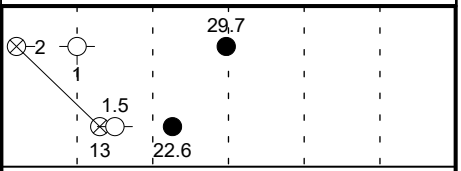
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 536

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4.00"]		536	
	S-1	SS	24	24	(CL FILL) FILL, LEAN CLAY, trace sand, brown, gray, moist, firm		535	WOH WOH 2
	S-2	SS	24	24	(CL FILL) FILL, LEAN CLAY WITH SAND, brown, gray, moist, stiff			4 4 6
					END OF BORING @ 4'			7 10
5							530	
10							525	
15							520	
20							515	
25							510	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/E WS ☐ WD ☒	BORING STARTED 12/05/18	CAVE IN DEPTH 1.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/05/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 50**

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-13	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION 100%

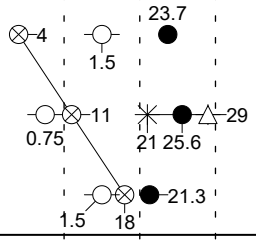
SURFACE ELEVATION 540

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	21		540	WOH 1 3
	S-2	SS	24	23			6 3 4
5	S-3	SS	24	24		535	7 7 5 7 11 12
10						530	
15						525	
20						520	
25						515	
30						510	

Topsoil Thickness [6.00"]

(CL) LEAN CLAY WITH SAND, brown, tan, and red, moist, soft to stiff

END OF BORING @ 6'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/E WS ☐ WD ☒	BORING STARTED 12/06/18	CAVE IN DEPTH 3.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/07/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 51**

CUMRU FIRE DEPARTMENT **BID/PERMIT SET**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591-A	B-14	1 OF 1

PROJECT NAME: Cumru Township Municipal Building 2

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks, PA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 545

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [5.00"]		545	WOH
	S-1	SS	24	17	(CL FILL) FILL, LEAN CLAY, trace sand, dark brown, moist, firm			2 3 4 5 6 6 7
	S-2	SS	24	24	(CL FILL) FILL, LEAN CLAY WITH SAND, brown and gray, moist, stiff			3 6 11 19
5	S-3	SS	24	24	(SP) SAND, trace clay, trace gravel, brown, tan, and gray, moist, medium dense		540	
					END OF BORING @ 6'			
10							535	
15							530	
20							525	
25							520	
30							515	

5 — 12 — 17

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/E WS ☐ WD ☒	BORING STARTED 12/06/18	CAVE IN DEPTH 3.0'
WL(SHW) WL(ACR)	BORING COMPLETED 12/06/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Matt	DRILLING METHOD HSA

GEOTECHNICAL REPORT **00 3132a - 52**

CLIENT	Job #:	BORING #	SHEET
Manns Woodward Studios	18:4591	B-01*	1 OF 1

PROJECT NAME: Cumru Township Fire Station

ARCHITECT-ENGINEER:

SITE LOCATION: 1775 Welsh Road, Mohnton, Berks County, PA

NORTHING	EASTING	STATION
40.2802260	-75.9707040	

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ——

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

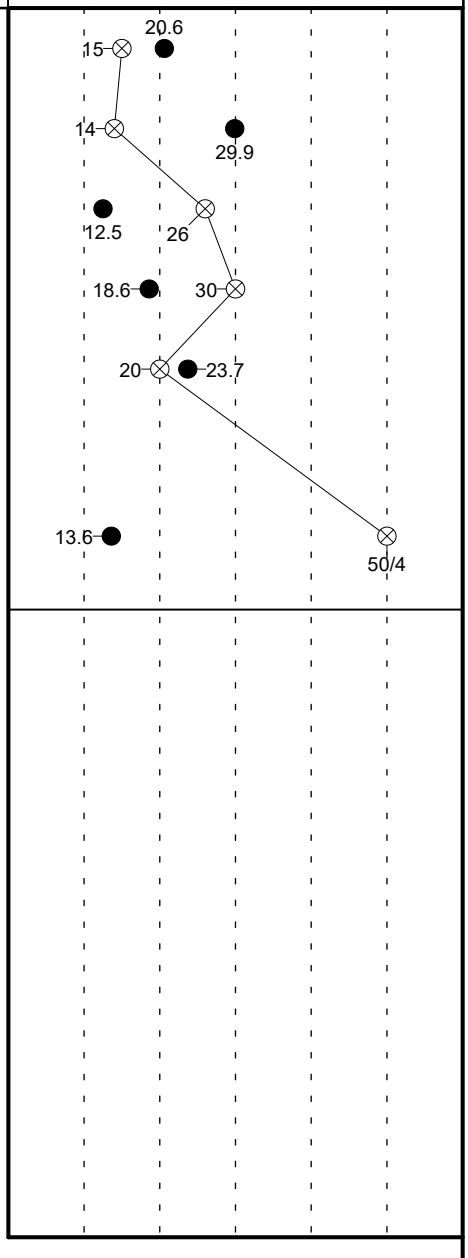
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 544

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [7.00"]			
	S-1	SS	24	24	(ML) SILT, dark brown, moist, medium dense, trace organics			1 7 8
	S-2	SS	24	21	(CL) SANDY LEAN CLAY, brown, moist, stiff, trace organics			5 2 6
							540	8 10 4
5	S-3	SS	24	22	(SM) SILTY SAND, gray, light brown to brown, moist, medium dense			10 16 21
	S-4	SS	24	18				19 15 15
	S-5	SS	24	21			535	17 6 8 12 26
10								
	S-6	SS	4	4	(SC) CLAYEY SAND, brown, moist, very dense, Augered to 15 after spoon refusal.		530	50/4
15					END OF BORING @ 15'			
							525	
20								
							520	
25								
							515	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL NE WS ☐ WD ☒	BORING STARTED 07/17/18	CAVE IN DEPTH
WL(SHW) NE WL(ACR) NE	BORING COMPLETED 07/17/18	HAMMER TYPE Manual
WL NE	RIG Truck FOREMAN Jake	DRILLING METHOD HSA

PROJECT NAME: Cumru Township Fire Station

TEST PIT #: TP-0*

CLIENT: Manns Woodward Studios

Job #: 18:4591

SURFACE ELEVATION (FT): 537

LOCATION: 1775 Welsh Road, Mohnton, Berks County, PA

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT
0		Topsoil Depth [10.00"]	
	535	(SM) SILTY SAND, orange, moist, medium dense	E
2.5			
	532.5	(GP) GRAVEL WITH SAND, tan, moist, dense	M
5			
		BASALT, Highly Weathered, Hard, Gray	D
	530	(GP) GRAVEL WITH SAND, brown, moist, medium dense, Limiting Zone- Ground Water at 8.75'.	E
7.5			
	527.5		
10		END OF TEST PIT @ 10.20'	
	525		
12.5			
	522.5		
15			
	520		
17.5			

DCP | QP (TSF) | SAMPLE NO. | MOIST. CONT. (%)

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼ EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR:	OPERATOR:	MAKE/MODEL:	REACH:
Irish Creek Excavating, Inc.	Dean	Deere/310 SG	14

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Encountered:	Groundwater Prior to Backfill:
David Blake	07/18/18			8.75	

CUMRU FIRE DEPARTMENT

BID/PERMIT SET

PROJECT NAME: CumruTownship Fire Station

TEST PIT #: TP-1*

CLIENT: Manns Woodward Studios

Job #: 18:4591

SURFACE ELEVATION (FT): 533

LOCATION: 1775 Welsh Road, Mohnton, Berks County, PA

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0	532.5	Topsoil Depth [10.00"]					
		(SC) CLAYEY SAND, tan, moist, medium dense, orange mottles					
2.5	530	(ML) SANDY SILT, gray to tan to orange to dark orange, moist, medium dense	E				
5	527.5	(SP) SAND, dark orange, wet, medium dense, limiting zone - ground water at 6.83'. sheen on water, probably non- organic.					
7.5	525	END OF TEST PIT @ 7.33'					
10	522.5						
12.5	520						
15	517.5						
17.5	515						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼ | EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR:	OPERATOR:	MAKE/MODEL:	REACH:
Irish Creek Excavating, Inc.	Dean	Deere/310 SG	14

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Encountered:	Groundwater Prior to Backfill:
David Blake	07/18/18			6.83	

PROJECT NAME: Cumru Township Fire Station

TEST PIT #: TP-2*

CLIENT: Manns Woodward Studios

Job #: 18:4591

SURFACE ELEVATION (FT): 533

LOCATION: 1775 Welsh Road, Mohnton, Berks County, PA

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0	532.5	Topsoil Depth [9.00"]					
		(SC) CLAYEY SAND, gray, moist, medium dense, well graded, contains oranges mottles, vugely					
		(SP-SC) SAND WITH CLAY, brown, moist to wet, medium dense, limiting zone- ground water at 2.5'.					
2.5	530		E				
5	527.5	END OF TEST PIT @ 5.17'					
7.5	525						
10	522.5						
12.5	520						
15	517.5						
17.5	515						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼ EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR:	OPERATOR:	MAKE/MODEL:	REACH:
Irish Creek Excavating, Inc.	Dean	Deere/310 SG	14

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Encountered:	Groundwater Prior to Backfill:
David Blake	07/18/18			2.50	

PROJECT NAME: Cumru Township Fire Station

TEST PIT #: TP-3*

CLIENT: Manns Woodward Studios

Job #: 18:4591

SURFACE ELEVATION (FT): 536

LOCATION: 1775 Welsh Road, Mohnton, Berks County, PA

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Depth [9.00"]					
	535	(SC) CLAYEY SAND, gray, moist, medium dense, well graded, orange mottles, vugely	E				
		(ML) SANDY SILT, orange, moist, medium dense					
2.5		(ML) SANDY SILT, tan to light orange to dark orange, moist, dense, limiting zone - water table from 6.17' to 7.67'					
	532.5						
5			M				
	530						
7.5		(ML) SILT, dark orange, wet, dense					
	527.5	END OF TEST PIT @ 8.50'					
10							
	525						
12.5							
	522.5						
15							
	520						
17.5							
	517.5						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼ EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR:	OPERATOR:	MAKE/MODEL:	REACH:
Irish Creek Excavating, Inc.	Dean	Deere/310 SG	14

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Encountered:	Groundwater Prior to Backfill:
David Blake	07/18/18			6.17	

PROJECT NAME:		TEST PIT #:
Cumru Township Fire Station		TP-4*
CLIENT:	Job #:	SURFACE ELEVATION (FT)
Manns Woodward Studios	18:4591	545
LOCATION: 1775 Welsh Road, Mohnton, Berks County, PA	ARCH/ENG:	

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0	545	Topsoil Depth [19.00"]					
		(ML) SANDY SILT, brown, moist, medium dense	E				
2.5	542.5						
5	540						
		(ML) SILT WITH GRAVEL, gray/ brown, moist, dense	M				
		END OF TEST PIT @ 6.83'					
7.5	537.5						
10	535						
12.5	532.5						
15	530						
17.5	527.5						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼ EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR:	OPERATOR:	MAKE/MODEL:	REACH:
Irish Creek Excavating, Inc.	Dean	Deere/310 SG	14

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Encountered:	Groundwater Prior to Backfill:
David Blake	07/18/18			NE	

SOIL CLASSIFICATION LEGEND

GW - WELL GRADED GRAVEL
GM - SILTY GRAVEL
GP - POORLY GRADED GRAVEL
GC - CLAYEY GRAVEL
SW - WELL GRADED SAND
ML - LOW PLASTICITY SILT
ST - SHELBY TUBE
CL - LOW PLASTICITY CLAY
MH - HIGH PLASTICITY SILT
SM - SILTY SAND
RC - ROCK CORE
SP - POORLY GRADED SAND
SC - CLAYEY SAND
CH - HIGH PLASTICITY CLAY
PM - PRESSURE METER
OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS
OL - LOW PLASTICITY ORGANIC SILTS AND CLAY
PT - PEAT
NOTE: NUMBERS IMMEDIATELY TO THE LEFT OF THE BORING PROFILE ARE SPT-N VALUES.
WR - WEATHERED ROCK
PWR - PARTIALLY WEATHERED ROCK
FILL
POSSIBLE FILL
PROBABLE FILL

SURFACE MATERIALS

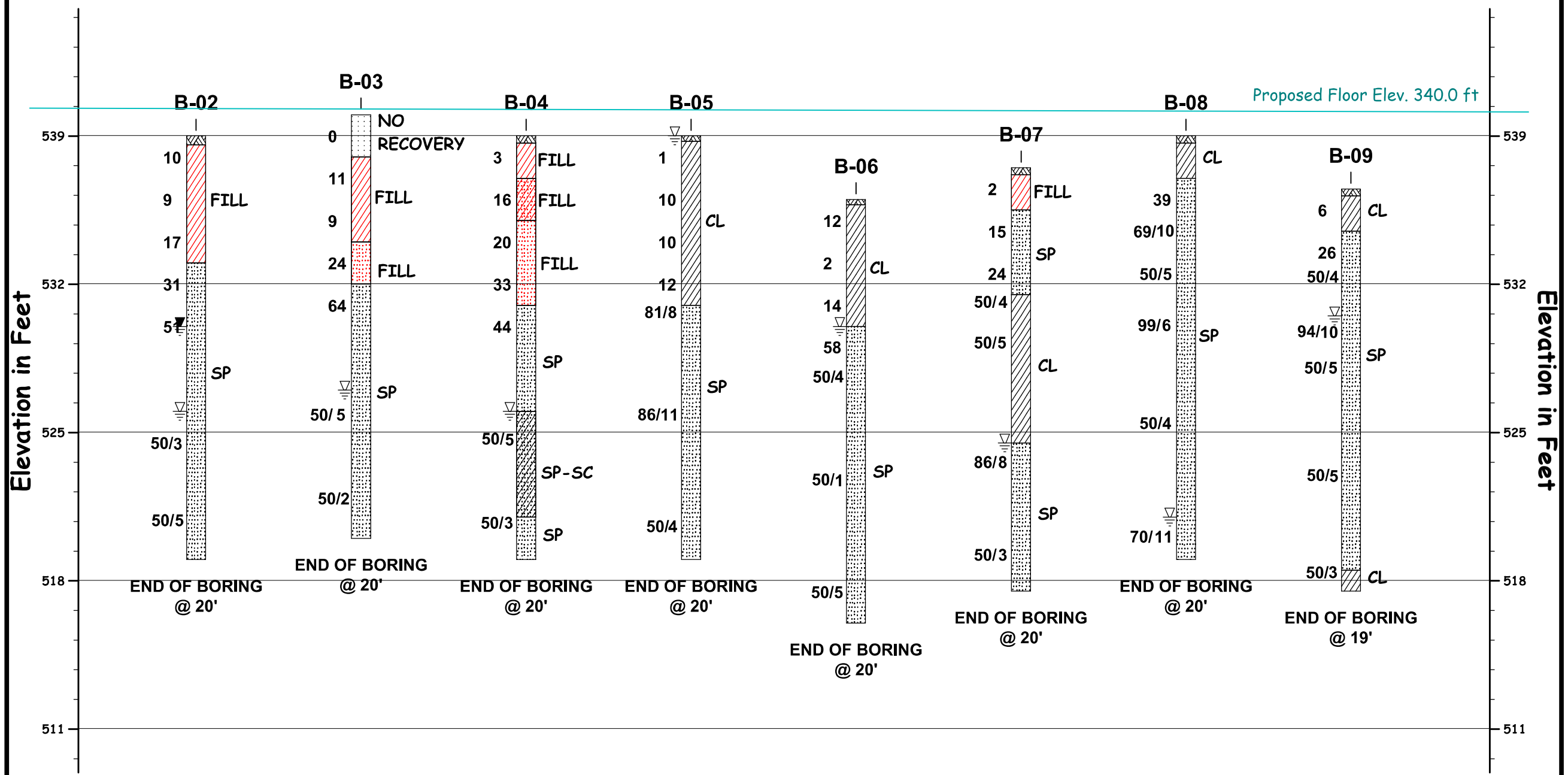
TOPSOIL
CONCRETE
ASPHALT
VOID
GRAVEL

ROCK TYPES

IGNEOUS
METAMORPHIC
SEDIMENTARY

SYMBOL LEGEND

WATER LEVEL - DURING DRILLING/SAMPLING
WATER LEVEL - SEASONAL HIGH WATER
WATER LEVEL - AFTER CASING REMOVAL
WATER LEVEL - AFTER 24 HOURS
PLASTIC LIMIT% | WATER CONTENT% | % PASSING #200 SIEVE [88%] | LIQUID LIMIT%



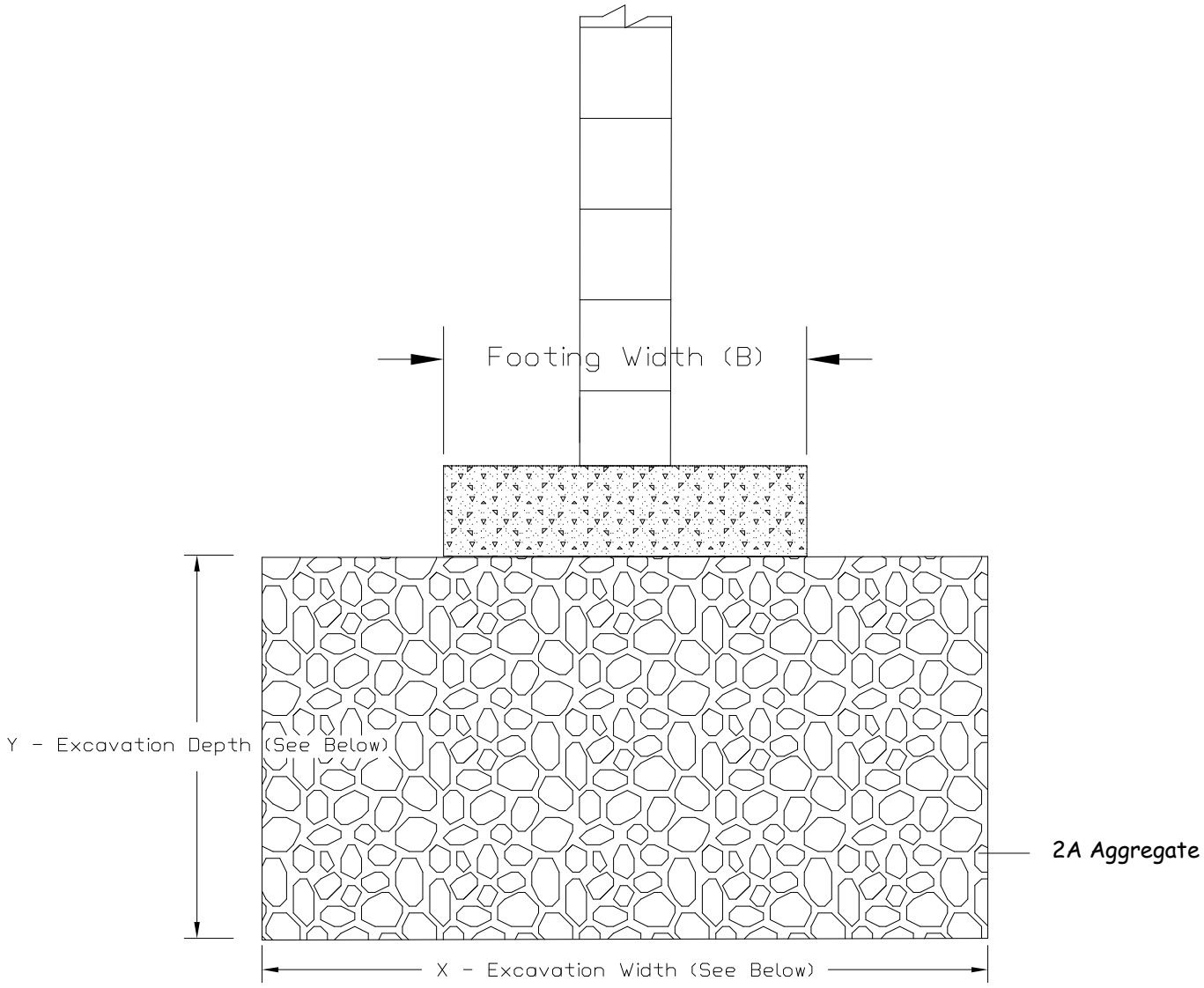
NOTES:
1 SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
2 PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586).

Subsurface Soil Profile

Cumru Township Municipal Building 2
Manns Woodward Studios
1775 Welsh Road, Mohnton, Berks, PA

PROJECT NO.4591-A | DATE:1/17/2019 | VERTICAL SCALE:1"=7'

ECS LLC MID-ATLANTIC
56 GRUMBACHER ROAD
SUITE D
YORK, PENNSYLVANIA 17402
PHONE : (717) 767-4788
FAX : (717) 767-5658



All Building Footings: Y=Depth of Fill (minimum of 2 feet)

X= Footing Width plus 2 feet for every 1 foot of excavation depth

Excavation bottom should be observed by Geotechnical Engineer or his qualified representative.

Replace overexcavated soil with compacted 2A Aggregate.

Compact 2A aggregate in 8–inch lifts to 95% of Standard Proctor (ASTMD 698)

Footing Subgrade Repair ©

i\departments\geotechnical\drafting\footingsubgraderepair2.dwg

ECS Project # 18.4951-A
Cumru Township Municipal Building
Cased Borehole Infiltration Testing Field Measurements

Date Tested:12/4/2018 - 12/6/2018

Field Data	B-10		B-11		B-12		B-13		B-14	
Test Depth	5.0'		4.0'		2.0'		4.0'		4.0'	
	Time	Drop	Time	Drop	Time	Drop	Time	Drop	Time	Drop
Initial Water Depth (ft)	1:07	-	1:42	-	11:01	-	11:04	-	11:10	-
Presoak 30 Min	1:37	0.30	2:12	0.01	11:31	0.00	11:34	0.06	11:40	0.20
Presoak 60 Min	2:07	0.01	2:42	0.00	12:01	0.00	12:04	0.01	12:10	0.09
Reading Interval	30 min		30 min		30 min		30 min		30 min	
Reading # 1 (ft)	2:07	0.00	2:42	0.00	12:01	0.00	12:04	0.01	12:10	0.04
Reading # 2 (ft)	2:37	0.00	3:12	0.00	12:31	0.00	12:34	0.00	12:40	0.05
Reading # 3 (ft)	3:07	0.00	3:42	0.00	13:01	0.00	13:04	0.00	13:10	0.05
Reading # 4 (ft)	3:37	0.00	4:12	0.00	13:31	0.00	13:34	0.01	13:40	0.03
Reading # 5 (ft)										
Reading # 6 (ft)										
Reading # 7 (ft)										
Reading # 8 (ft)										
Diameter of Casing (in)	4.00		4.00		4.00		4.00		4.00	
Final Water Level Drop (ft)	0.00		0.00		0.00		0.01		0.03	
Average Reading (ft)	0.00		0.00		0.00		0.01		0.04	
Average Reading (in)	0.00		0.00		0.00		0.06		0.51	
Average Reading (in/hr)	0.00		0.00		0.00		0.12		1.02	
Safety Factor	2.00		2.00		2.00		2.00		2.00	
Infiltration Rate (in/hr)	0.00		0.00		0.00		0.06		0.51	

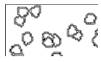
ECS Project # 18.4951-A
Cumru Township Municipal Building
Cased Borehole Infiltration Testing Field Measurements

Date Tested:7/18/2018

Field Data	TP-0A		TP-0B		TP-4A		TP-4B					
Test Depth	1.0'		1.0'		3.0'		3'.0					
	Time	Reading	Time	Reading	Time	Reading	Time	Reading	Time	Reading	Time	Reading
Presoak Start/Water Depth	12:25	6"	12:25	6"	11:36	6"	11:36	6"				
Presoak 30 Min	12:55	3.125"	12:55	3"	12:06	0.375"	12:06	0.25"				
Presoak 60 Min	1:25	1.625"	1:25	1.875"	12:36	0.0625"	12:36	0.125"				
START TEST	1:25	6"	1:25	6"	12:36	6"	12:36	6"				
Reading Interval	30 min		30 min		30 min		30 min					
Reading # 1 (in)	1:55	1.38	1:55	1.88	1:06	0.06	1:06	0.00				
Reading # 2 (in)	2:25	1.13	2:25	1.63	1:36	0.00	1:36	0.06				
Reading # 3 (in)	2:55	1.13	2:55	1.63	2:06	0.00	2:06	0.00				
Reading # 4 (in)	3:25	1.13	3:25	1.63	2:36	0.00	2:36	0.00				
Reading # 5 (in)												
Reading # 6 (in)												
Reading # 7 (in)												
Reading # 8 (in)												
O.D. of Double Ring Infiltrometer (in)	6.00		6.00		6.00		6.00					
Initial Water Depth (in)	6.00		6.00		6.00		6.00					
Final Water Level Drop (in)	1.13		1.63		0.00		0.00					
Average Reading (in)	1.19		1.69		0.02		0.02					
Infiltration Rate (in/hr)	2.38		3.38		0.03		0.03					
Safety Factor	2.00		2.00		2.00		2.00					
Corrected Infiltration Rate (in/hr)	**1.19**		**1.69**		**0.02**		**0.02**					

1. Infiltrometer refilled to water depth of 6 inches (inner and outer ring) after each reading.

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]		
		ASPHALT
		CONCRETE
		GRAVEL
		TOPSOIL
		VOID
		BRICK
		AGGREGATE BASE COURSE
	FILL[3]	MAN-PLACED SOILS
	GW	WELL-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GP	POORLY-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GM	SILTY GRAVEL gravel-sand-silt mixtures
	GC	CLAYEY GRAVEL gravel-sand-clay mixtures
	SW	WELL-GRADED SAND gravelly sand, little or no fines
	SP	POORLY-GRADED SAND gravelly sand, little or no fines
	SM	SILTY SAND sand-silt mixtures
	SC	CLAYEY SAND sand-clay mixtures
	ML	SILT non-plastic to medium plasticity
	MH	ELASTIC SILT high plasticity
	CL	LEAN CLAY low to medium plasticity
	CH	FAT CLAY high plasticity
	OL	ORGANIC SILT or CLAY non-plastic to low plasticity
	OH	ORGANIC SILT or CLAY high plasticity
	PT	PEAT highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS			
SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION		
DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS		
UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS	
SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
Dual Symbol *(ex: SW-SM)*	10	10
With	15 - 20	15 - 25
Adjective *(ex: "Silty")*	≥25	≥30

WATER LEVELS[6]		
	WL	Water Level (WS)(WD) (WS) While Sampling (WD) While Drilling
	SHW	Seasonal High WT
	ACR	After Casing Removal
	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

[1] *Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.*

[2] *To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.*

[3] *Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-**FILL**)].*

[4] *Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).*

[5] *Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).*

[6] *The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.*

[7] *Minor deviation from ASTM D 2488-09 Note 16.*

[8] *Percentages are estimated to the nearest 5% per ASTM D 2488-09.*

Lab Summaries
Atterberg Limits
Grain Size Analysis
USDA Classification

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-01												
	S-1	0.00 - 2.00	22.6									
	S-2	2.00 - 4.00	18.4									
	S-3	4.00 - 6.00	15.9									
	S-4	6.00 - 8.00	20.1	CL	29	21	8	54.4				
	S-5	8.00 - 10.00	41.2									
	S-6	13.00 - 15.00	8.9									
	S-7	18.00 - 19.42	7.7									
B-02												
	S-1	0.00 - 2.00	18.4									
	S-2	2.00 - 4.00	31.6									
	S-3	4.00 - 6.00	16.0									
	S-4	6.00 - 8.00	13.3									
	S-5	8.00 - 10.00	8.2									
B-03												
	S-2	2.00 - 4.00	23.1									
	S-3	4.00 - 6.00	23.0									
	S-4	6.00 - 8.00	14.3									
	S-5	8.00 - 10.00	9.2									
B-04												
	S-1	0.00 - 2.00	33.0									
	S-2	2.00 - 4.00	17.1									
	S-3	4.00 - 6.00	16.0									
	S-4	6.00 - 8.00	13.7									
	S-5	8.00 - 10.00	10.0									
	S-6	13.00 - 13.92	44.7									
B-05												
	S-3	4.00 - 6.00	20.0	CL	42	23	19	89.5				

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

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Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-06												
	S-3	4.00 - 6.00	6.9	SC-SM	25	21	4	36.5				
B-07												
B-08												
	S-1	0.00 - 2.00	35.9									
	S-2	2.00 - 4.00	10.1									
	S-3	4.00 - 5.33	14.9									
	S-4	6.00 - 8.00	18.5									
	S-5	8.00 - 10.00	19.5									
	S-6	13.00 - 15.00	9.1									
	S-7	18.00 - 20.00	12.5									
B-09												
B-10												
B-11												
	S-1	0.00 - 2.00	24.3									
	S-2	2.00 - 4.00	25.7									
	S-3	4.00 - 6.00	11.7									
B-12												
	S-1	0.00 - 2.00	29.7									
	S-2	2.00 - 4.00	22.6									
B-13												
	S-1	0.00 - 2.00	23.7									
	S-2	2.00 - 4.00	25.6	CL	29	21	8	77.6				
	S-3	4.00 - 6.00	21.3									
B-14												

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

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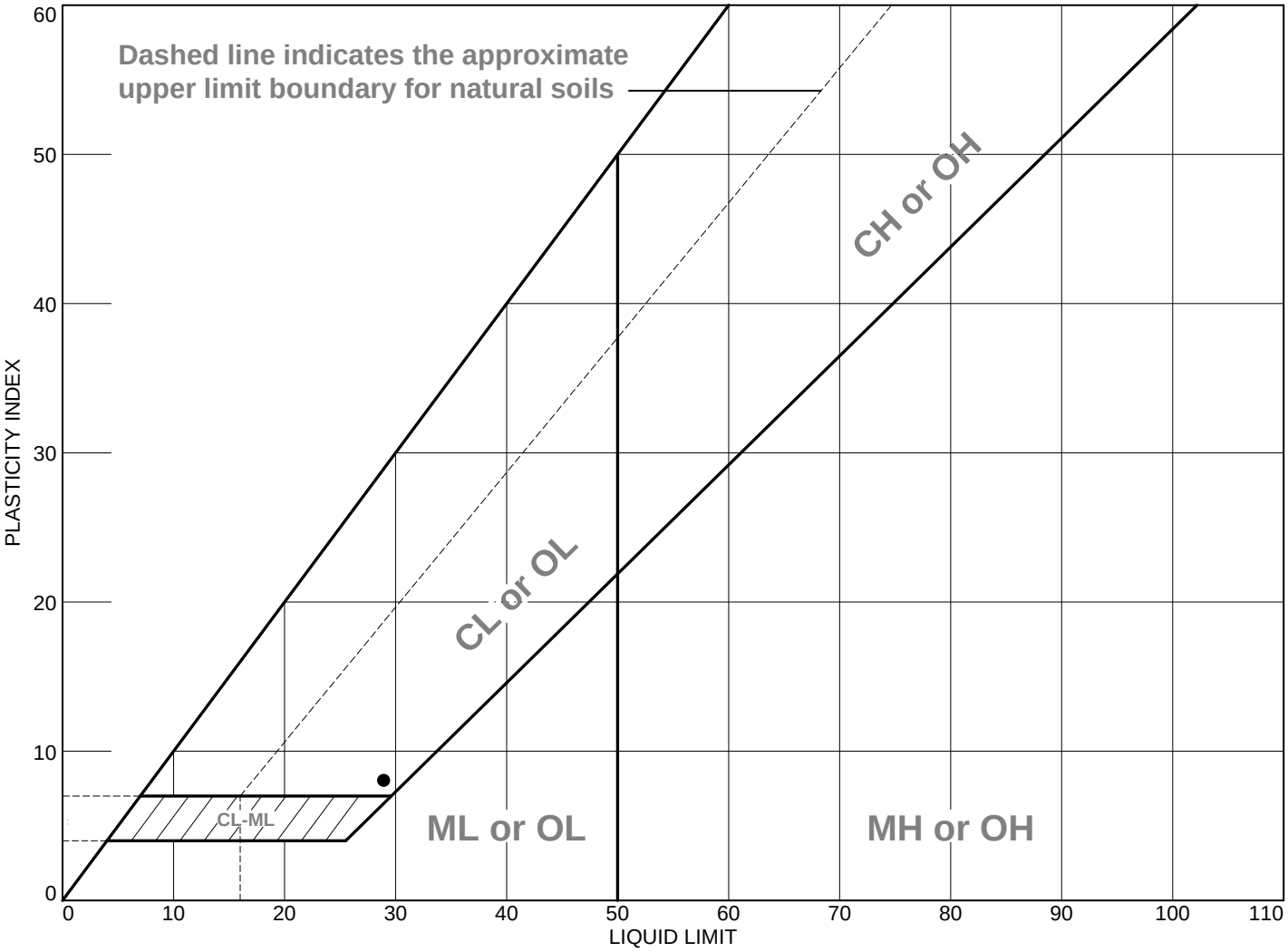
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Lean CLAY	29	21	8	58.0	54.4	CL

Project No. 4591-A **Client:** Manns Woodward Studios

Project: Cumru Township Municipal Building 2

●**Source of Sample:** B-01 **Depth:** 6.00-8.00 **Sample Number:** S-4

Remarks:

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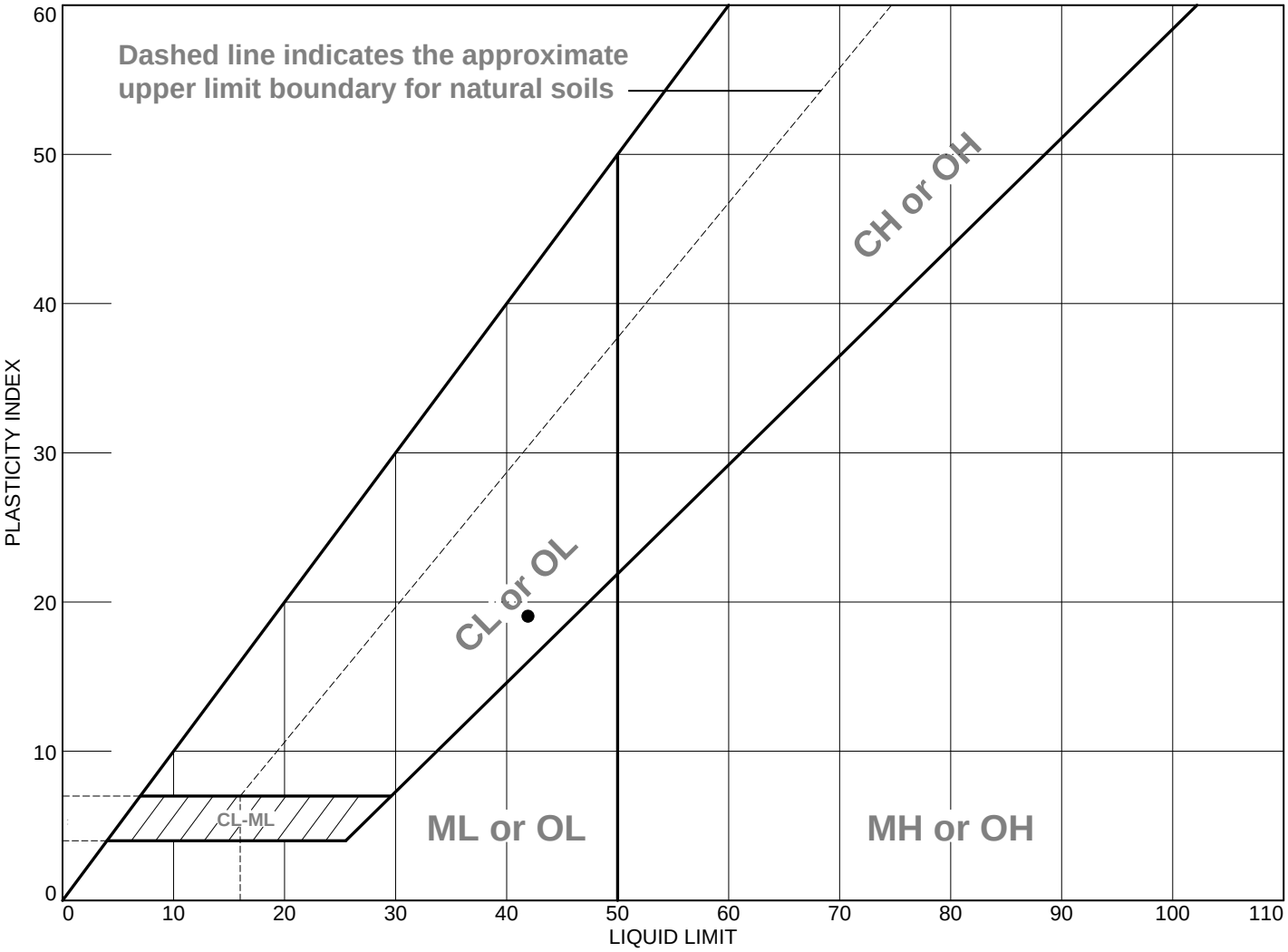
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY	42	23	19	91.0	89.5	CL

Project No. 4591-A **Client:** Manns Woodward Studios

Project: Cumru Township Municipal Building 2

●**Source of Sample:** B-05 **Depth:** 4.00-6.00 **Sample Number:** S-3

Remarks:

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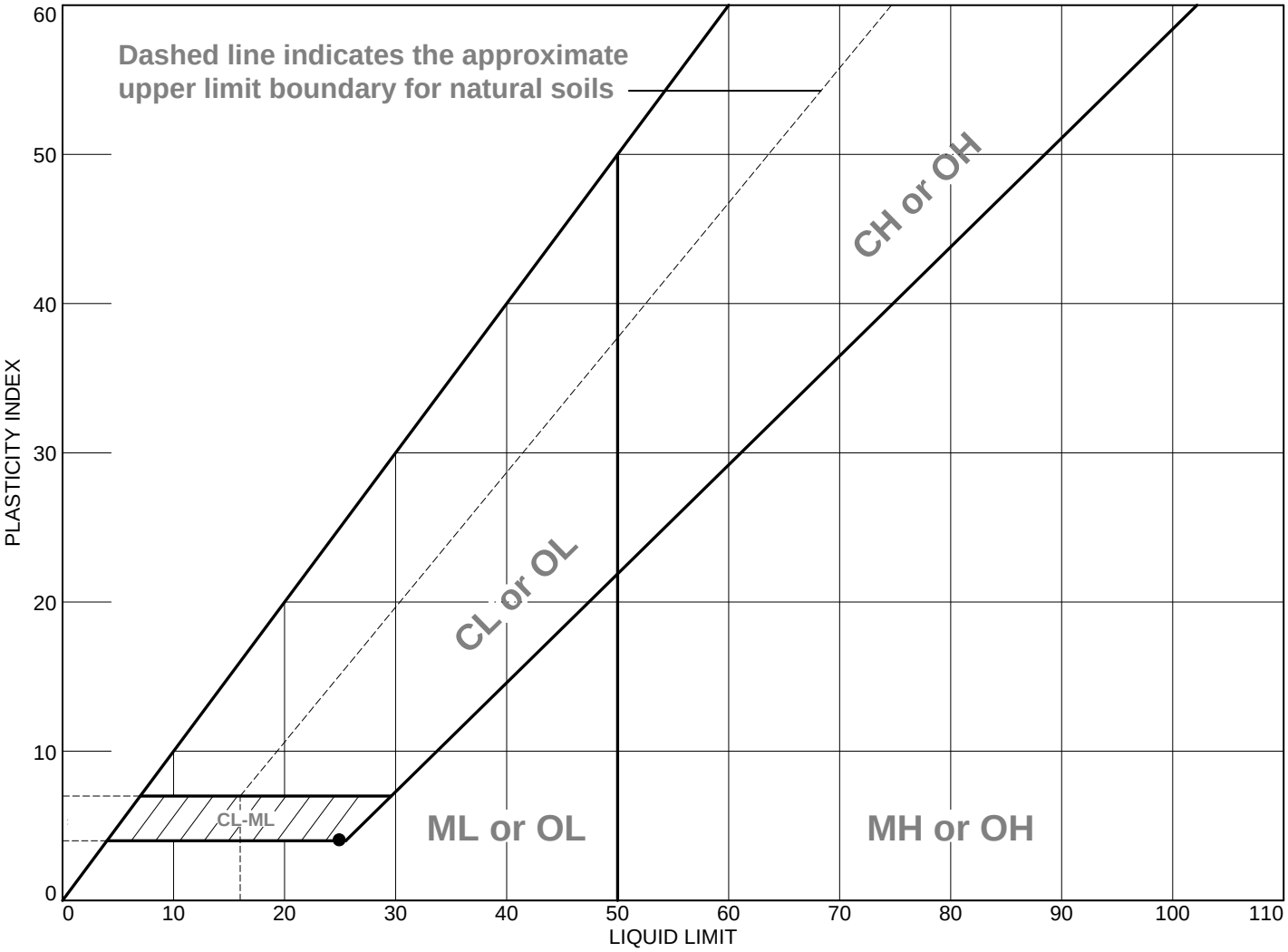
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Clayey SAND	25	21	4	48.9	36.5	SC-SM

Project No. 4591-A **Client:** Manns Woodward Studios

Project: Cumru Township Municipal Building 2

●**Source of Sample:** B-06 **Depth:** 4.00-6.00 **Sample Number:** S-3

Remarks:

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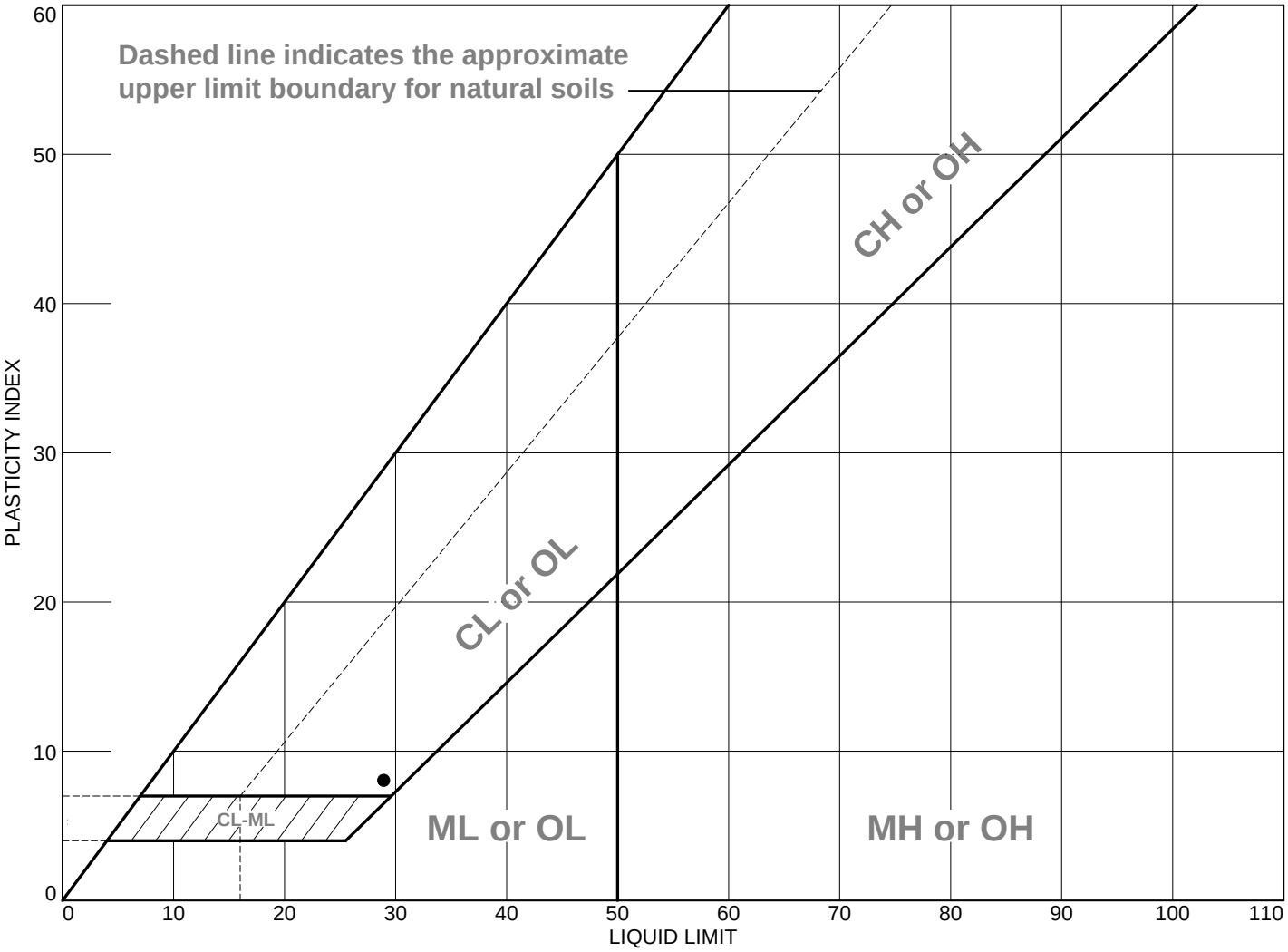
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with Sand	29	21	8	85.0	77.6	CL

Project No. 4591-A **Client:** Manns Woodward Studios

Project: Cumru Township Municipal Building 2

●**Source of Sample:** B-13 **Depth:** 2.00-4.00 **Sample Number:** S-2

Remarks:

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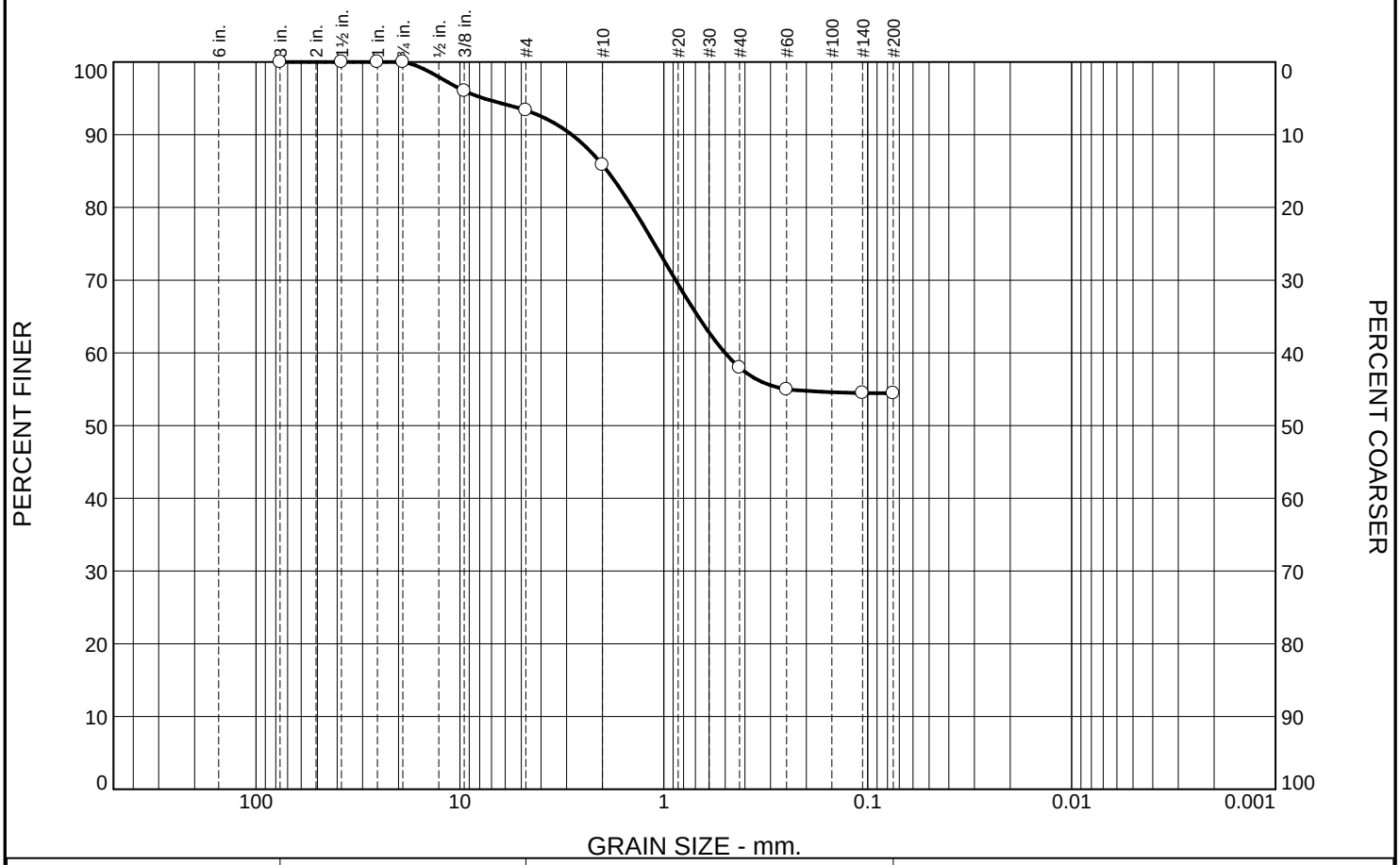
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.7	7.4	27.9	3.6	54.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
1 1/2	100.0		
1	100.0		
3/4	100.0		
3/8	96.0		
#4	93.3		
#10	85.9		
#40	58.0		
#60	55.0		
#140	54.5		
#200	54.4		

* (no specification provided)

Material Description

Sandy Lean CLAY

Atterberg Limits

PL= 21 LL= 29 PI= 8

Classification

USCS= CL AASHTO= A-4(2)

Remarks

Source of Sample: B-01 **Depth:** 6.00-8.00
Sample Number: S-4 **Date:**

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Client: Manns Woodward Studios
Project: Cumru Township Municipal Building 2

Project No: 4591-A **Figure**

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.3	7.7	1.5	89.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
1 1/2	100.0		
1	100.0		
3/4	100.0		
3/8	100.0		
#4	100.0		
#10	98.7		
#40	91.0		
#60	89.8		
#100	89.5		
#200	89.5		

* (no specification provided)

Material Description

Lean CLAY

Atterberg Limits

PL= 23 LL= 42 PI= 19

Classification

USCS= CL AASHTO= A-7-6(18)

Remarks

Source of Sample: B-05 **Depth:** 4.00-6.00
Sample Number: S-3 **Date:**

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Client: Manns Woodward Studios
Project: Cumru Township Municipal Building 2

Project No: 4591-A **Figure**

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.7	8.7	34.7	12.4	28.7	7.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
1 1/2	100.0		
1	100.0		
3/4	100.0		
3/8	99.1		
#4	92.3		
#10	83.6		
#40	48.9		
#60	42.1		
#100	37.0		
#200	36.5		

* (no specification provided)

Material Description

Silty Clayey SAND

Atterberg Limits

PL= 21 LL= 25 PI= 4

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Source of Sample: B-06 **Depth:** 4.00-6.00
Sample Number: S-3 **Date:**

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Client: Manns Woodward Studios
Project: Cumru Township Municipal Building 2

Project No: 4591-A **Figure**

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.0	1.9	10.1	7.4	54.1	23.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
1 1/2	100.0		
1	100.0		
3/4	100.0		
3/8	100.0		
#4	97.0		
#10	95.1		
#40	85.0		
#60	80.9		
#100	77.9		
#200	77.6		

* (no specification provided)

Material Description

Lean CLAY with Sand

Atterberg Limits

PL= 21 LL= 29 PI= 8

Classification

USCS= CL AASHTO= A-4(5)

Remarks

Source of Sample: B-13 **Depth:** 2.00-4.00
Sample Number: S-2 **Date:**

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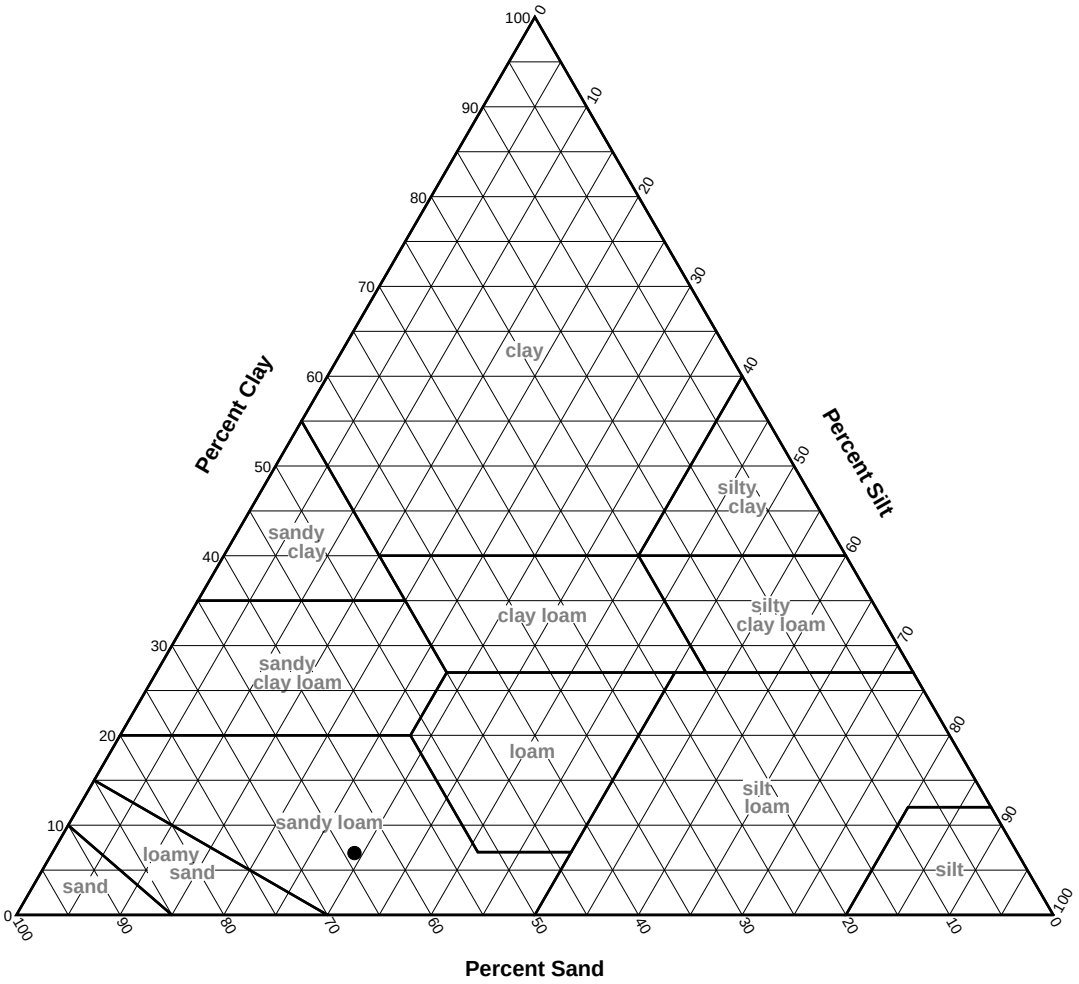
Client: Manns Woodward Studios
Project: Cumru Township Municipal Building 2

Project No: 4591-A **Figure**

USDA Soil Classification



SOIL DATA

	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	B-06	S-3	4.00-6.00	63.9	29.3	6.8	Sandy loam

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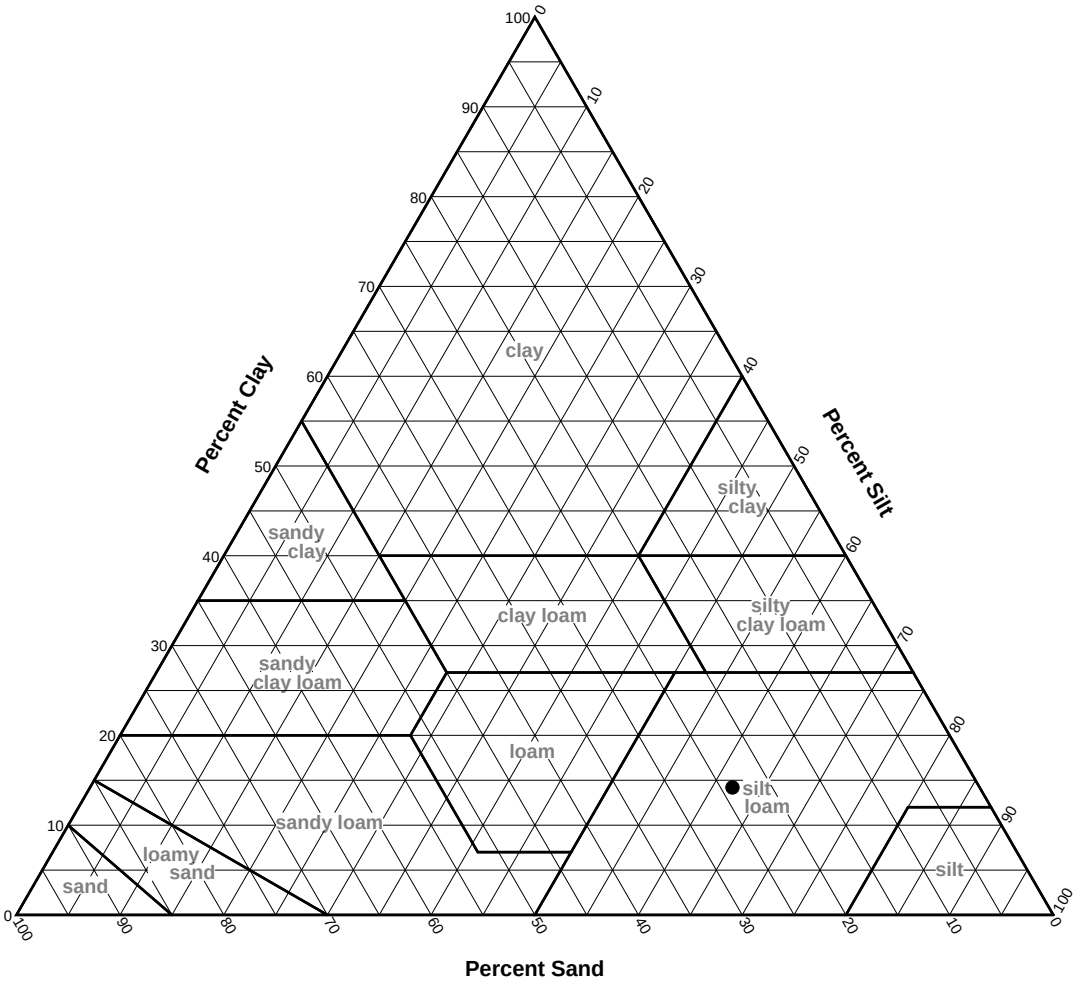
Client: Manns Woodward Studios

Project: Cumru Township Municipal Building 2

Project No.: 4591-A

Figure

USDA Soil Classification



SOIL DATA

	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	B-13	S-2	2.00-4.00	23.8	62.1	14.1	Silt loam

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Client: Manns Woodward Studios

Project: Cumru Township Municipal Building 2

Project No.: 4591-A

Figure

SECTION 00 4321 - ALLOWANCE FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Bid Package (Prime Contract Package): _____.

C. Project Name: Cumru Township, Cumru Fire Department, Station 42.

D. Project Location: 1775 Welsh Road, Mohnton PA 19540.

E. Owner: The Cumru Township.

F. Architect: Manns Woodward Studios, Inc..

G. Architect Project Number: 18-036.

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

B. The undersigned Bidder certifies that Base Bid submission to which this Bid Supplement is attached includes those allowances described in the Contract Documents and scheduled in Section 01 2100 "Allowances."

1.3 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2024.

B. Submitted By:_____(Insert 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).

END OF DOCUMENT 004321

SECTION 00 4322 - UNIT PRICES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Bid Package (Prime Contract Package): _____.

C. Project Name: Cumru Township, Cumru Fire Department, Station 42.

A. Project Location: 1775 Welsh Road, Mohnton PA 19540.

B. Owner: The Cumru Township.

C. Architect: Manns Woodward Studios Inc.

D. Architect Project Number: 18-036

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

B. The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work and for adjustment of the quantity given in the Unit-Price Allowance for the actual measurement of individual items of the Work.

C. If the unit price does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

1.3 UNIT PRICES

A. Unit Price No. 1: Removal of Unsatisfactory Soil
_____dollars ($_____) per unit.

B. Unit Price No. 2: Rock Removal
_____dollars ($_____) per unit

C. Unit Price No. 3: Soil Moisture Reduction; Quicklime
_____dollars ($_____) per unit

D. Unit Price No. 4: PennDOT 2A Fill
_____dollars ($_____) per unit

E. Unit Price No. 5: #57 Stone Fill
_____dollars ($_____) per unit

F. Unit Price No. 6: Granular natural soil fill
_____dollars ($_____) per unit

G. Unit Price No. 7: Concrete Curbing
_____dollars($_____) per unit

H. Unit Price No. 8: Concrete Sidewalk
_____dollars($_____) per unit

1.4 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2024.

B. Submitted By:_____(Insert 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).

END OF DOCUMENT 004322

SECTION 00 4323 - ALTERNATES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Bid Package (Prime Contract Package): _____.

C. Project Name: Cumru Township, Cumru Fire Department, Station 42.

D. Project Location: 1775 Welsh Road, Mohnton PA 19540.

E. Owner: The Cumru Township.

F. Architect: Manns Woodward Studios, Inc..

G. Architect Project Number: 18-036.

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

1.3 DESCRIPTION

A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment.

B. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE."

C. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

D. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within 60 days of the Notice of Award unless otherwise indicated in the Contract Documents.

E. Acceptance or non-acceptance of any alternates by the Owner shall have no affect on the Contract Time unless the "Schedule of Alternates" Article below provides a formatted space for the adjustment of the Contract Time.

1.4 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Omit Lobby and Meeting Room Casework:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

B. Alternate No. 2: Omit Resinous Flooring Integral Base:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

C. Alternate No. 3: Sealed Concrete In Lieu of Resinous Flooring:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

D. Alternate No. 4: Sectional Doors In Lieu of Four-Fold Doors:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

E. Alternate No. 5: Omit Steel Beam for Future Operable Partition:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

F. Alternate No. 6: Painted Gypsum Wall Board In Lieu of Wall Tile, Restrooms:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

G. Alternate No. 7: Add MVE-Control System to Interior Concrete Slabs On Grade to Mitigate High Slab Moisture Problems:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

H. Alternate No. 8: Solid Exterior Wall In Lieu of Rear Apparatus Bay Door FFB1-5R:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

I. Alternate No. 9: Lawn in Lieu of Rear Apron:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

J. Alternate No. 10: Reduce Standing Seam Roof Thickness:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).

1.5 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2021.

B. Submitted By:_____(Insert 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).

END OF DOCUMENT 004323

SECTION 00 4373 - PROPOSED SCHEDULE OF VALUES FORM

1.1 BID FORM SUPPLEMENT

A. A completed Proposed Schedule of Values form is required to be attached to the Bid Form.

1.2 PROPOSED SCHEDULE OF VALUES FORM

A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount, including alternates, in enough detail to facilitate continued evaluation of bid. Coordinate with the Project Manual table of contents. Provide multiple line items for principal material and subcontract amounts in excess of five percent of the Contract Sum.

B. Arrange schedule of values using AIA Document G703-1992.

1. Copies of AIA standard forms may be obtained from the American Institute of Architects; https://www.aiacontracts.org/ library; (800) 942-7732.

END OF DOCUMENT 004373

DOCUMENT 004393 - BID SUBMITTAL CHECKLIST

1.1 BID INFORMATION

A. Bidder: _____.

B. Prime Contract: _____.

C. Project Name: Cumru Fire Department.

D. Project Location: 1775 Welsh Road, Mohnton PA 19540.

E. Owner: Cumru Township.

F. Architect: Manns Woodward Studios, Inc..

1.2 BIDDER'S CHECKLIST

A. In an effort to assist the Bidder in properly completing all documentation required, the following checklist is provided for the Bidder's convenience. The Bidder is solely responsible for verifying compliance with bid submittal requirements.

B. Include this completed checklist along with all other required bid submittal requirements. Below is a list of items required to be submitted through the procurement website:

1. Electronic Bid Forms: Complete all blanks on electronic bid forms within procurement website. Bid Forms should include the following items. Where any of the following items are not included on the procurement website, complete the paper copy and upload with electronic bid submission.
   a. Bid Form 1A
   b. Bid Form 15A
   c. Bid Form 15B
   d. Bid Form 16A
   e. Allowance Form
   f. Unit Price Form
   g. Alternates Form

2. Supplemental Bid Documents: Upload the following document with the electronic bid submission through the procurement website:
   a. Bid Bond 1A
   b. Bid Bond 15A
   c. Bid Bond 15B
   d. Bid Bond 16A
   e. Bidders Check List

3. Contractors Affidavit
4. Contractors Release/Stipulation Against Liens
5. Owners Documents - Instructions to Bidders
6. Labor and Material Bond 1A
7. Labor and Material Bond 15A
8. Labor and Material Bond 15B
9. Labor and Material Bond 16A
10. Maintenance Bond 1A Paving
11. Maintenance Bond 1A
12. Maintenance Bond 15A
13. Maintenance Bond 15B
14. Maintenance Bond 16A
15. Non Collusion Affidavit 1A
16. Non Collusion Affidavit 15A
17. Non Collusion Affidavit 15B
18. Non Collusion Affidavit 16A
19. Performance Bond 1A
20. Performance Bond 15A
21. Performance Bond 15B
22. Performance Bond 16A
23. Prevailing Wage and Public Works Employment Verification Act
24. Public Works Employment Verification Form
25. Statement of Surety
26. Cumru Township Fire Station, Prevailing Wage Project Rates

END OF DOCUMENT 004393

SECTION 00 4400 - OWNERS DOCUMENTS

1.1 OWNERS DOCUMENTS - BID FORMS

A. Owner's document(s) bound following this Section.

1. Bid Bond 1A
2. Bid Bond 15A
3. Bid Bond 15B
4. Bid Bond 16A
5. Bid Form 1A
6. Bid Form 15A
7. Bid Form 15B
8. Bid Form 16A
9. Bidders Check List
10. Contractors Affidavit
11. Contractors Release/Stipulation Against Liens
12. Owners Documents - Instructions to Bidders
13. Labor and Material Bond 1A
14. Labor and Material Bond 15A
15. Labor and Material Bond 15B
16. Labor and Material Bond 16A
17. Maintenance Bond 1A Paving
18. Maintenance Bond 1A
19. Maintenance Bond 15A
20. Maintenance Bond 15B
21. Maintenance Bond 16A
22. Non Collusion Affidavit 1A
23. Non Collusion Affidavit 15A
24. Non Collusion Affidavit 15B
25. Non Collusion Affidavit 16A
26. Performance Bond 1A
27. Performance Bond 15A
28. Performance Bond 15B
29. Performance Bond 16A
30. Prevailing Wage and Public Works Employment Verification Act
31. Public Works Employment Verification Form
32. Statement of Surety
33. Cumru Township Fire Station, Prevailing Wage Project Rates

END OF SECTION 00 4400

Bid Bond – General Building Construction 1A

KNOW ALL MEN BY THESE PRESENTS, that we _____

_____

(hereinafter called the "Principal") as Principal, and _____,

a _____ Corporation authorized to transact business in _____and

having its principal office at _____
(hereinafter called the "Surety") as Surety, are held and firmly bound unto the Township of Cumru
(hereinafter called the Obligee), in the sum of

_____DOLLARS ($ _____),
lawful money of the United States of America; for payment of which we bind ourselves, and each of our respective heirs, legal representatives, successors and assigns, jointly and severally, by these presents on the _____ day of _____20 _____.

WHEREAS, said Principal is herewith submitting to the Obligee a proposal to perform the for the Obligee's proposed Contract No. 1A – CUMRU FIRE DEPARTMENT pursuant to Specifications and other Contract Documents incorporated into said proposal by reference; and it is a condition of the Obligee's receipt and consideration of said proposal that the proposal be accompanied by Bid security to be held by the Obligee on terms embodied herein.

NOW, THEREFORE, the condition of this obligation is that if said Principal shall furnish Performance Bond, Labor and Material Payment Bond, and Insurance Certificates to the Obligee upon the Obligee's delivery to the Principal of notice of intention to accept his proposal and to make a formal award of contract to him, and shall enter into such contract, all as required by said Contract Documents, then this obligation shall be void; otherwise it shall remain in full force, and the Principal and Surety will pay to the Obligee the full amount of this Bond as liquidated damages and not as a penalty.

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Bid Bond Mechanical Construction 15A

KNOW ALL MEN BY THESE PRESENTS, that we _____

_____

(hereinafter called the "Principal") as Principal, and _____,

a _____ Corporation authorized to transact business in _____and

having its principal office at _____
(hereinafter called the "Surety") as Surety, are held and firmly bound unto the Township of Cumru
(hereinafter called the Obligee), in the sum of

_____DOLLARS ($ _____),
lawful money of the United States of America; for payment of which we bind ourselves, and each of our respective heirs, legal representatives, successors and assigns, jointly and severally, by these presents on the _____ day of _____20 _____.

WHEREAS, said Principal is herewith submitting to the Obligee a proposal to perform the for the Obligee's proposed Contract No. 15A – CUMRU FIRE DEPARTMENT pursuant to Specifications and other Contract Documents incorporated into said proposal by reference; and it is a condition of the Obligee's receipt and consideration of said proposal that the proposal be accompanied by Bid security to be held by the Obligee on terms embodied herein.

NOW, THEREFORE, the condition of this obligation is that if said Principal shall furnish Performance Bond, Labor and Material Payment Bond, and Insurance Certificates to the Obligee upon the Obligee's delivery to the Principal of notice of intention to accept his proposal and to make a formal award of contract to him, and shall enter into such contract, all as required by said Contract Documents, then this obligation shall be void; otherwise it shall remain in full force, and the Principal and Surety will pay to the Obligee the full amount of this Bond as liquidated damages and not as a penalty.

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Bid Bond Plumbing Construction 15B

KNOW ALL MEN BY THESE PRESENTS, that we _____

_____

(hereinafter called the "Principal") as Principal, and _____,

a _____ Corporation authorized to transact business in _____and

having its principal office at _____
(hereinafter called the "Surety") as Surety, are held and firmly bound unto the Township of Cumru
(hereinafter called the Obligee), in the sum of

_____DOLLARS ($ _____),
lawful money of the United States of America; for payment of which we bind ourselves, and each of our respective heirs, legal representatives, successors and assigns, jointly and severally, by these presents on the _____ day of _____20 _____.

WHEREAS, said Principal is herewith submitting to the Obligee a proposal to perform the for the Obligee's proposed Contract No. 15B – CUMRU FIRE DEPARTMENT pursuant to Specifications and other Contract Documents incorporated into said proposal by reference; and it is a condition of the Obligee's receipt and consideration of said proposal that the proposal be accompanied by Bid security to be held by the Obligee on terms embodied herein.

NOW, THEREFORE, the condition of this obligation is that if said Principal shall furnish Performance Bond, Labor and Material Payment Bond, and Insurance Certificates to the Obligee upon the Obligee's delivery to the Principal of notice of intention to accept his proposal and to make a formal award of contract to him, and shall enter into such contract, all as required by said Contract Documents, then this obligation shall be void; otherwise it shall remain in full force, and the Principal and Surety will pay to the Obligee the full amount of this Bond as liquidated damages and not as a penalty.

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Bid Bond Electrical Construction 16A

KNOW ALL MEN BY THESE PRESENTS, that we _____

_____

(hereinafter called the "Principal") as Principal, and _____,

a _____ Corporation authorized to transact business in _____and

having its principal office at _____
(hereinafter called the "Surety") as Surety, are held and firmly bound unto the Township of Cumru
(hereinafter called the Obligee), in the sum of

_____DOLLARS ($ _____),
lawful money of the United States of America; for payment of which we bind ourselves, and each of our respective heirs, legal representatives, successors and assigns, jointly and severally, by these presents on the _____ day of _____20 _____.

WHEREAS, said Principal is herewith submitting to the Obligee a proposal to perform the for the Obligee's proposed Contract No. 16A – CUMRU FIRE DEPARTMENT pursuant to Specifications and other Contract Documents incorporated into said proposal by reference; and it is a condition of the Obligee's receipt and consideration of said proposal that the proposal be accompanied by Bid security to be held by the Obligee on terms embodied herein.

NOW, THEREFORE, the condition of this obligation is that if said Principal shall furnish Performance Bond, Labor and Material Payment Bond, and Insurance Certificates to the Obligee upon the Obligee's delivery to the Principal of notice of intention to accept his proposal and to make a formal award of contract to him, and shall enter into such contract, all as required by said Contract Documents, then this obligation shall be void; otherwise it shall remain in full force, and the Principal and Surety will pay to the Obligee the full amount of this Bond as liquidated damages and not as a penalty.

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Bid Form – General Building Construction 1A

1. (Notice: This Bid must be executed in ink or by typed entries, and it must not be removed from this document)

Bid Of: _____
(Bidder's Name)

For Contract #1A

Title: Cumru Fire Department

To: Cumru Township
1775 Welsh Road
Mohnton, PA 19540

herein called the Owner.

Note - All pricing information shall be submitted electronically via the "Bid" tab.

1. Intentionally left blank.

2. The Bidder agrees to begin work within ten (10) calendar days of the date designated in the Notice to Proceed, and to substantially complete the work ready for Owner use within 420 calendar days from the date designated in the Notice to Proceed and to complete the entire Contract ready for final payment and ready for closeout in accordance with 01 7700 CLOSEOUT PROCEDURES, within 450 calendar days from the date designated in the Notice to Proceed.

3. In case of failure on the part of the Contractor to substantially complete the work within the respective time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum of ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is substantially completed or accepted. In case of failure on the part of the Contractor to totally complete the work ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES within the time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is totally completed ready for final payment.

4. The undersigned agrees, upon receipt of written notice of the acceptance of this Bid within sixty (60) days after the date of opening of Bids, to execute the Construction Contract, in accordance with the Bid as accepted unless it is necessary to delay the award in order to obtain governmental approvals or complete the sale of the Bonds, in which case the award will be within one hundred and twenty (120) calendar days after the date of Bid opening. The undersigned also agrees to give the Bonds required with good and sufficient Surety or Sureties.

5. Payment for all work called for in the Drawings and Specifications or required for proper completion of the work under this Contract and not specifically mentioned in the Drawings and Specifications

will be considered as covered by the unit price payments and no extra payments will be allowed therefore.

6. The undersigned hereby designates as his office to which such notice of acceptance may be mailed, telegraphed or delivered:

_____

_____

7. Accompanying this proposal is a _____ in the amount of _____

_____ DOLLARS and _____ CENTS ($_____) as Bid security.

8. This Bid may be withdrawn at any time prior to the scheduled time for the opening of Bids or any authorized postponement thereof.

9. The undersigned acknowledges that he received the following Addenda to the Specifications and that this Bid was prepared in accordance with said Addenda:

Addendum No. Date of Addendum

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

10. UNIT PRICE WORK

The Bidder understands that the quantities in unit price work are approximate only and are presented solely for the Owner's use in comparing Bids. He understands and agrees that the Owner may increase or decrease the quantity of work to be done under any item. He further agrees that in case of any error or inconsistency in the figures contained in the proposal, the unit prices shall govern, and that if his proposal is accepted, the unit prices contained in the proposal are the unit prices which he will receive and which the Owner will pay for the work specified to be done under the items, in the manner set forth and required by the Contract Documents, without recitation or repetition of said unit prices in the Contract Agreement.

11. BIDDER'S REPRESENTATIONS

A. The Bidder, in submitting the attached Bid, represents that prior to Bidding,

1 To the extent he deems it necessary or desirable, he has reviewed the Drawings and Specifications, visited the proposed site and made all site, soil and subsurface tests.

2 He has had ample opportunity to request clarification from the Owner and the Engineer about any part of the Drawings and Specifications and Bid Documents which are not entirely clear to him or about which he has any questions or reservations and that, to the extent he has requested clarifications, he has received satisfactory responses; and

3 He has carefully reviewed the Drawings and Specifications for the purpose of detecting any inconsistencies between the Drawings and Specifications (or any items included in the Drawings but not in the Specifications, or in the Specifications but not in the Drawings), and, to the extent he has observed any such inconsistencies and/or omissions, he has duly noted them and has had an adequate opportunity to request clarification from the Owner and Engineer, and he has received a satisfactory response with respect thereto.

A. INDIVIDUAL

An individual doing business under the firm name of:

_____

Address: _____

Individual's Name: _____ (Sign)

_____ (Type)

Witness: _____ Date: _____

B. PARTNERSHIP

Partners trading and doing business under the firm name of:

_____

Address: _____

Partner's Names:

_____ (Sign) _____ (Sign)

_____ (Type) _____ (Type)

Witness: _____ Date: _____

C. CORPORATION

Name: _____

Address: _____

A Corporation organized under the laws of : _____

Officer: _____ (Sign)

_____ (Type)

Attest: _____ Date: _____
(Secretary)

(CORPORATE SEAL)

Bid Form – Mechanical Construction 15A

1. (Notice: This Bid must be executed in ink or by typed entries, and it must not be removed from this document)

Bid Of: _____
(Bidder's Name)

For Contract #15A

Title: Cumru Fire Department

To: Cumru Township
1775 Welsh Road
Mohnton, PA 19540

herein called the Owner.

Note - All pricing information shall be submitted electronically via the "Bid" tab.

1. Intentionally left blank.

2. The Bidder agrees to begin work within ten (10) calendar days of the date designated in the Notice to Proceed, and to substantially complete the work ready for Owner use within 420 calendar days from the date designated in the Notice to Proceed and to complete the entire Contract ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES, within 450 calendar days from the date designated in the Notice to Proceed.

3. In case of failure on the part of the Contractor to substantially complete the work within the respective time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum of ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is substantially completed or accepted. In case of failure on the part of the Contractor to totally complete the work ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES within the time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is totally completed ready for final payment.

4. The undersigned agrees, upon receipt of written notice of the acceptance of this Bid within sixty (60) days after the date of opening of Bids, to execute the Construction Contract, in accordance with the Bid as accepted unless it is necessary to delay the award in order to obtain governmental approvals or complete the sale of the Bonds, in which case the award will be within one hundred and twenty (120) calendar days after the date of Bid opening. The undersigned also agrees to give the Bonds required with good and sufficient Surety or Sureties.

5. Payment for all work called for in the Drawings and Specifications or required for proper completion of the work under this Contract and not specifically mentioned in the Drawings and Specifications

will be considered as covered by the unit price payments and no extra payments will be allowed therefore.

6. The undersigned hereby designates as his office to which such notice of acceptance may be mailed, telegraphed or delivered:

_____

_____

7. Accompanying this proposal is a _____ in the amount of _____

_____ DOLLARS and _____ CENTS ($_____) as Bid security.

8. This Bid may be withdrawn at any time prior to the scheduled time for the opening of Bids or any authorized postponement thereof.

9. The undersigned acknowledges that he received the following Addenda to the Specifications and that this Bid was prepared in accordance with said Addenda:

Addendum No. Date of Addendum

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

10. UNIT PRICE WORK

The Bidder understands that the quantities in unit price work are approximate only and are presented solely for the Owner's use in comparing Bids. He understands and agrees that the Owner may increase or decrease the quantity of work to be done under any item. He further agrees that in case of any error or inconsistency in the figures contained in the proposal, the unit prices shall govern, and that if his proposal is accepted, the unit prices contained in the proposal are the unit prices which he will receive and which the Owner will pay for the work specified to be done under the items, in the manner set forth and required by the Contract Documents, without recitation or repetition of said unit prices in the Contract Agreement.

11. BIDDER'S REPRESENTATIONS

A. The Bidder, in submitting the attached Bid, represents that prior to Bidding,

1 To the extent he deems it necessary or desirable, he has reviewed the Drawings and Specifications, visited the proposed site and made all site, soil and subsurface tests.

2 He has had ample opportunity to request clarification from the Owner and the Engineer about any part of the Drawings and Specifications and Bid Documents which are not entirely clear to him or about which he has any questions or reservations and that, to the extent he has requested clarifications, he has received satisfactory responses; and

3 He has carefully reviewed the Drawings and Specifications for the purpose of detecting any inconsistencies between the Drawings and Specifications (or any items included in the Drawings but not in the Specifications, or in the Specifications but not in the Drawings), and, to the extent he has observed any such inconsistencies and/or omissions, he has duly noted them and has had an adequate opportunity to request clarification from the Owner and Engineer, and he has received a satisfactory response with respect thereto.

A. INDIVIDUAL

An individual doing business under the firm name of:

_____

Address: _____

Individual's Name: _____ (Sign)

_____ (Type)

Witness: _____ Date: _____

B. PARTNERSHIP

Partners trading and doing business under the firm name of:

_____

Address: _____

Partner's Names:

_____ (Sign) _____ (Sign)

_____ (Type) _____ (Type)

Witness: _____ Date: _____

C. CORPORATION

Name: _____

Address: _____

A Corporation organized under the laws of : _____

Officer: _____ (Sign)

_____ (Type)

Attest: _____ Date: _____
(Secretary)

(CORPORATE SEAL)

Bid Form – Plumbing Construction 15B

1. (Notice: This Bid must be executed in ink or by typed entries, and it must not be removed from this document)

Bid Of: _____
(Bidder's Name)

For Contract #15B

Title: Cumru Fire Department

To: Cumru Township
1775 Welsh Road
Mohnton, PA 19540

herein called the Owner.

Note - All pricing information shall be submitted electronically via the "Bid" tab.

1. Intentionally left blank.

2. The Bidder agrees to begin work within ten (10) calendar days of the date designated in the Notice to Proceed, and to substantially complete the work ready for Owner use within 420 calendar days from the date designated in the Notice to Proceed and to complete the entire Contract ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES, within 450 calendar days from the date designated in the Notice to Proceed.

3. In case of failure on the part of the Contractor to substantially complete the work within the respective time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum of ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is substantially completed or accepted. In case of failure on the part of the Contractor to totally complete the work ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES within the time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is totally completed ready for final payment.

4. The undersigned agrees, upon receipt of written notice of the acceptance of this Bid within sixty (60) days after the date of opening of Bids, to execute the Construction Contract, in accordance with the Bid as accepted unless it is necessary to delay the award in order to obtain governmental approvals or complete the sale of the Bonds, in which case the award will be within one hundred and twenty (120) calendar days after the date of Bid opening. The undersigned also agrees to give the Bonds required with good and sufficient Surety or Sureties.

5. Payment for all work called for in the Drawings and Specifications or required for proper completion of the work under this Contract and not specifically mentioned in the Drawings and Specifications

will be considered as covered by the unit price payments and no extra payments will be allowed therefore.

6. The undersigned hereby designates as his office to which such notice of acceptance may be mailed, telegraphed or delivered:

_____

_____

7. Accompanying this proposal is a _____ in the amount of _____

_____ DOLLARS and _____ CENTS ($_____) as Bid security.

8. This Bid may be withdrawn at any time prior to the scheduled time for the opening of Bids or any authorized postponement thereof.

9. The undersigned acknowledges that he received the following Addenda to the Specifications and that this Bid was prepared in accordance with said Addenda:

Addendum No. Date of Addendum

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

10. UNIT PRICE WORK

The Bidder understands that the quantities in unit price work are approximate only and are presented solely for the Owner's use in comparing Bids. He understands and agrees that the Owner may increase or decrease the quantity of work to be done under any item. He further agrees that in case of any error or inconsistency in the figures contained in the proposal, the unit prices shall govern, and that if his proposal is accepted, the unit prices contained in the proposal are the unit prices which he will receive and which the Owner will pay for the work specified to be done under the items, in the manner set forth and required by the Contract Documents, without recitation or repetition of said unit prices in the Contract Agreement.

11. BIDDER'S REPRESENTATIONS

A. The Bidder, in submitting the attached Bid, represents that prior to Bidding,

1 To the extent he deems it necessary or desirable, he has reviewed the Drawings and Specifications, visited the proposed site and made all site, soil and subsurface tests.

2 He has had ample opportunity to request clarification from the Owner and the Engineer about any part of the Drawings and Specifications and Bid Documents which are not entirely clear to him or about which he has any questions or reservations and that, to the extent he has requested clarifications, he has received satisfactory responses; and

3 He has carefully reviewed the Drawings and Specifications for the purpose of detecting any inconsistencies between the Drawings and Specifications (or any items included in the Drawings but not in the Specifications, or in the Specifications but not in the Drawings), and, to the extent he has observed any such inconsistencies and/or omissions, he has duly noted them and has had an adequate opportunity to request clarification from the Owner and Engineer, and he has received a satisfactory response with respect thereto.

A. INDIVIDUAL

An individual doing business under the firm name of:

_____

Address: _____

Individual's Name: _____ (Sign)

_____ (Type)

Witness: _____ Date: _____

B. PARTNERSHIP

Partners trading and doing business under the firm name of:

_____

Address: _____

Partner's Names:

_____ (Sign) _____ (Sign)

_____ (Type) _____ (Type)

Witness: _____ Date: _____

C. CORPORATION

Name: _____

Address: _____

A Corporation organized under the laws of : _____

Officer: _____ (Sign)

_____ (Type)

Attest: _____ Date: _____
(Secretary)

(CORPORATE SEAL)

Bid Form – Electrical Construction 16A

1. (Notice: This Bid must be executed in ink or by typed entries, and it must not be removed from this document)

Bid Of: _____
(Bidder's Name)

For Contract #16A

Title: Cumru Fire Department

To: Cumru Township
1775 Welsh Road
Mohnton, PA 19540

herein called the Owner.

Note - All pricing information shall be submitted electronically via the "Bid" tab.

1. Intentionally left blank.

2. The Bidder agrees to begin work within ten (10) calendar days of the date designated in the Notice to Proceed, and to substantially complete the work ready for Owner use within 420 calendar days from the date designated in the Notice to Proceed and to complete the entire Contract ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES, within 450 calendar days from the date designated in the Notice to Proceed.

3. In case of failure on the part of the Contractor to substantially complete the work within the respective time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum of ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is substantially completed or accepted. In case of failure on the part of the Contractor to totally complete the work ready for final payment and ready for closeout in accordance with Section 01 7700 CLOSEOUT PROCEDURES within the time fixed in the Contract or any extensions thereof, the Contractor shall pay the Owner as liquidated damages (but not as a penalty) the sum ONE THOUSAND DOLLARS and ZERO CENTS ($1,000.00) for each calendar day of delay until the work is totally completed ready for final payment.

4. The undersigned agrees, upon receipt of written notice of the acceptance of this Bid within sixty (60) days after the date of opening of Bids, to execute the Construction Contract, in accordance with the Bid as accepted unless it is necessary to delay the award in order to obtain governmental approvals or complete the sale of the Bonds, in which case the award will be within one hundred and twenty (120) calendar days after the date of Bid opening. The undersigned also agrees to give the Bonds required with good and sufficient Surety or Sureties.

5. Payment for all work called for in the Drawings and Specifications or required for proper completion of the work under this Contract and not specifically mentioned in the Drawings and Specifications

will be considered as covered by the unit price payments and no extra payments will be allowed therefore.

6. The undersigned hereby designates as his office to which such notice of acceptance may be mailed, telegraphed or delivered:

_____

_____

7. Accompanying this proposal is a _____ in the amount of _____

_____ DOLLARS and _____ CENTS ($_____) as Bid security.

8. This Bid may be withdrawn at any time prior to the scheduled time for the opening of Bids or any authorized postponement thereof.

9. The undersigned acknowledges that he received the following Addenda to the Specifications and that this Bid was prepared in accordance with said Addenda:

Addendum No. Date of Addendum

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

10. UNIT PRICE WORK

The Bidder understands that the quantities in unit price work are approximate only and are presented solely for the Owner's use in comparing Bids. He understands and agrees that the Owner may increase or decrease the quantity of work to be done under any item. He further agrees that in case of any error or inconsistency in the figures contained in the proposal, the unit prices shall govern, and that if his proposal is accepted, the unit prices contained in the proposal are the unit prices which he will receive and which the Owner will pay for the work specified to be done under the items, in the manner set forth and required by the Contract Documents, without recitation or repetition of said unit prices in the Contract Agreement.

11. BIDDER'S REPRESENTATIONS

A. The Bidder, in submitting the attached Bid, represents that prior to Bidding,

1 To the extent he deems it necessary or desirable, he has reviewed the Drawings and Specifications, visited the proposed site and made all site, soil and subsurface tests.

2 He has had ample opportunity to request clarification from the Owner and the Engineer about any part of the Drawings and Specifications and Bid Documents which are not entirely clear to him or about which he has any questions or reservations and that, to the extent he has requested clarifications, he has received satisfactory responses; and

3 He has carefully reviewed the Drawings and Specifications for the purpose of detecting any inconsistencies between the Drawings and Specifications (or any items included in the Drawings but not in the Specifications, or in the Specifications but not in the Drawings), and, to the extent he has observed any such inconsistencies and/or omissions, he has duly noted them and has had an adequate opportunity to request clarification from the Owner and Engineer, and he has received a satisfactory response with respect thereto.

A. INDIVIDUAL

An individual doing business under the firm name of:

_____

Address: _____

Individual's Name: _____ (Sign)

_____ (Type)

Witness: _____ Date: _____

B. PARTNERSHIP

Partners trading and doing business under the firm name of:

_____

Address: _____

Partner's Names:

_____ (Sign) _____ (Sign)

_____ (Type) _____ (Type)

Witness: _____ Date: _____

C. CORPORATION

Name: _____

Address: _____

A Corporation organized under the laws of : _____

Officer: _____ (Sign)

_____ (Type)

Attest: _____ Date: _____
(Secretary)

(CORPORATE SEAL)

Bidder's Check List

The following items must be submitted with the Bid

A. Included herein (use the forms provided and or sourced by the bidding contractor)

1. Bid Forms - signed, sealed, if applicable, and titles.

2. Bid Guarantee (Bid Bond, signed and emboss sealed by Contractor, if applicable, and Surety, or Certified Check)

3. Information to be Furnished by the Bidder

4. Qualification Statement – AIA 305-2020 Contractor's Qualification Statement

5. Non Collusion Affidavit

6. Schedule of Values- AIA G703-1992 – Schedule of Values

7. Site Work – Measurements and Payments

8. 00 4321 – Allowance Form

9. 00 4322 - Unit Prices Form

10. 00 4323 – Alternates Form

B. To be provided by the Bidder (Surety Company's forms)

1. Certified copy of "Power of Attorney" for Attorney-In-Fact who signed the Bid Bond signed by an officer of the Surety, dated (date must be even with the Bid Bond) and embossed with Surety's seal.

2. Financial statement of the Surety Company.

3. Certificate from a Surety company certifying that the Surety would provide the required bonds if Bidder is awarded the Contract.

4. Provide Names and Federal Employer Identification Numbers of Contractor and all Subcontractors who will work on this project.

C. By submitting a Bid, the Bidder acknowledges that they have read and will comply with the insurance amounts and coverages as noted in the General Conditions.

D. By submitting a Bid, the Bidder acknowledges that they have read and will comply with the requirements contained in the grant information in the appendix.

Contractor's Affidavit

STATE OF: _____

COUNTY OF: _____

Before me, the undersigned, a _____
(Notary Public, Justice of the Peace or Alderman)

in and for said County and State, personally appeared

_____
(Individual, Partner or duly authorized representative of Corporate Contractor)

who being duly sworn according to law, deposes and says that all labor, material and outstanding claims and indebtedness of whatever nature arising out of the performance of the CONTRACT of the Township of Cumru
(Owner)

with _____ have been paid in full.
(Contractor)

_____
(Individual, Partner, or duly authorized representative of Corporate Contractor)

Sworn to and subscribed before me

this _____ day of

_____, 20 _____

_____ Notary Public _____
(Seal)

Contractor's Release/Stipulation Against Liens

KNOW ALL MEN BY THESE PRESENTS THAT: _____

_____
(Contractor)

of _____ County and State of _____

does hereby acknowledge that he has received this day, of and from the

Township of Cumru
(Owner)

the sum of ONE DOLLAR ($1.00) and other valuable consideration in full satisfaction and payment of all sums

of money owing payable and belonging to _____

_____
(Contractor)

by any means whatsoever for on account of a certain agreement hereinafter called the CONTRACT,

between the said Township of Cumru
(Owner)

and _____ dated _____
(Contractor)

NOW, THEREFORE, the said _____
(Contractor)

(for myself, my heirs, executors and administrators) (for itself, its successors and assigns) do by these presents remise, release, quit-claim, hold harmless, indemnify and forever discharge the said

Township of Cumru its successors and assigns, of
(Owner)

and from all claims and demands arising from or in connection with the said CONTRACT dated _____ and of and from all, and all manner of action and actions, cause or causes of action, money, accounts, reckonings, bonds, bills, specialties, covenants, contracts, agreements, promises, variances, damages, judgments, any and all attorneys' fees, extents, executions, claims and demand, whatsoever in law or equity, or otherwise which against the said

Township of Cumru
(Owner)

its successors and assigns, ever had, now have, or which (I, my heirs, executors, or administrators) (it, its successors and assigns) hereafter can, shall or may have, for upon or by reason of any matter, cause or thing whatsoever from the beginning of the world to the date of these presents.

IN WITNESS WHEREOF _____
(Contractor)

has caused these presents to be duly executed the _____ day of _____, 20 ____.

Signed, Sealed and Delivered
in the presence of:

_____ _____ (SEAL)
(Individual)

_____ _____ (SEAL)
(Partnership Contractor)

_____ _____ (SEAL)
(Partner)

Attest:

_____ (SEAL)

_____ _____ (SEAL)
(Secretary) (President or Vice President)

(CORPORATE SEAL)

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project Name:	Cumru Township Fire Station
Awarding Agency:	Township of Cumru
Contract Award Date:	1/29/2024
Serial Number:	23-09259
Project Classification:	Building/Highway
Determination Date:	11/28/2023
Assigned Field Office:	Scranton
Field Office Phone Number:	(570)963-4577
Toll Free Phone Number:	(877)214-3962
Project County:	Berks County

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-09259 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	7/27/2022		$35.80	$30.01	$65.81
Asbestos & Insulation Workers	6/26/2023		$38.70	$29.11	$67.81
Asbestos & Insulation Workers	7/1/2024		$35.80	$34.06	$69.86
Boilermakers	1/1/2023		$51.27	$35.30	$86.57
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/30/2023		$39.98	$17.17	$57.15
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/28/2024		$41.83	$17.17	$59.00
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/4/2025		$43.68	$17.17	$60.85
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2022		$33.56	$17.72	$51.28
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2023		$35.06	$17.72	$52.78
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2024		$36.56	$17.72	$54.28
Cement Finishers & Plasterers	4/30/2023		$28.23	$22.27	$50.50
Cement Finishers & Plasterers	4/28/2024		$30.23	$22.27	$52.50
Cement Finishers & Plasterers	5/4/2025		$32.23	$22.27	$54.50
Cement Finishers & Plasterers	5/3/2026		$34.23	$22.27	$56.50
Cement Masons	5/1/2023		$34.15	$20.60	$54.75
Dockbuilder, Pile Drivers	5/1/2023		$50.48	$37.99	$88.47
Dockbuilder, Pile Drivers	5/1/2024		$52.98	$37.99	$90.97
Dockbuilder, Pile Drivers	5/1/2025		$55.23	$37.99	$93.22
Dockbuilder, Pile Drivers	5/1/2026		$56.98	$37.99	$94.97
Dockbuilder/Pile Driver Diver	5/1/2023		$58.41	$41.74	$100.15
Dockbuilder/Pile Driver Diver	5/1/2024		$61.54	$41.74	$103.28
Dockbuilder/Pile Driver Diver	5/1/2025		$64.35	$41.74	$106.09
Dockbuilder/Pile Driver Diver	5/1/2026		$66.54	$41.74	$108.28
Dockbuilder/pile driver tender	5/1/2023		$50.48	$37.99	$88.47
Dockbuilder/pile driver tender	5/1/2024		$52.98	$37.99	$90.97
Dockbuilder/pile driver tender	5/1/2025		$55.23	$37.99	$93.22
Dockbuilder/pile driver tender	5/1/2026		$56.98	$37.99	$94.97
Drywall Finisher	5/1/2023		$30.10	$22.14	$52.24
Electricians	9/1/2022		$40.52	$25.63	$66.15
Electricians	9/1/2023		$42.02	$25.69	$67.71
Elevator Constructor	1/1/2023		$56.46	$38.36	$94.82
Floor Coverer	5/1/2023		$36.21	$18.36	$54.57
Floor Coverer	5/1/2024		$37.64	$18.36	$56.00
Glazier	5/1/2023		$37.71	$23.68	$61.39
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2021		$34.01	$31.13	$65.14
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2023		$36.26	$31.38	$67.64
Laborers (Class 01 - See notes)	5/1/2023		$27.62	$16.77	$44.39
Laborers (Class 02 - see notes)	5/1/2023		$29.62	$16.77	$46.39
Laborers (Class 03 - See notes)	5/1/2022		$29.62	$16.53	$46.15

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-09259 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 03 - See notes)	5/1/2023		$30.32	$17.03	$47.35
Laborers (Class 04 - See notes)	5/1/2022		$31.12	$16.53	$47.65
Laborers (Class 04 - See notes)	5/1/2023		$31.82	$16.78	$48.60
Laborers (Class 05 - See notes)	5/1/2023		$29.62	$16.77	$46.39
Laborers (Class 06 - See notes)	5/1/2022		$28.87	$16.28	$45.15
Marble Mason	5/1/2023		$35.81	$16.73	$52.54
Marble Mason	5/1/2024		$37.76	$16.73	$54.49
Marble Mason	5/1/2025		$39.71	$16.73	$56.44
Millwright	5/1/2019		$39.14	$20.08	$59.22
Millwright	6/1/2023		$39.21	$22.95	$62.16
Millwright	6/1/2024		$41.07	$22.95	$64.02
Millwright	6/1/2025		$43.00	$22.95	$65.95
Millwright	6/1/2026		$44.97	$22.95	$67.92
Operators (Building, Class 01 - See Notes)	5/1/2023		$42.57	$29.24	$71.81
Operators (Building, Class 01A - See Notes)	5/1/2023		$44.82	$29.90	$74.72
Operators (Building, Class 02 - See Notes)	5/1/2023		$42.29	$29.15	$71.44
Operators (Building, Class 02A - See Notes)	5/1/2023		$44.54	$29.82	$74.36
Operators (Building, Class 03 - See Notes)	5/1/2023		$39.57	$28.34	$67.91
Operators (Building, Class 04 - See Notes)	5/1/2023		$38.42	$28.02	$66.44
Operators (Building, Class 05 - See Notes)	5/1/2023		$37.97	$27.89	$65.86
Operators (Building, Class 06 - See Notes)	5/1/2023		$37.10	$27.62	$64.72
Operators (Building, Class 07A- See Notes)	5/1/2023		$51.63	$33.34	$84.97
Operators (Building, Class 07B- See Notes)	5/1/2023		$51.28	$33.24	$84.52
Painters Class 1 (see notes)	5/1/2023		$31.09	$23.19	$54.28
Painters Class 2 (see notes)	5/1/2023		$30.09	$23.19	$53.28
Painters Class 3 (see notes)	5/1/2017		$36.25	$18.17	$54.42
Piledrivers	5/1/2021		$43.73	$37.99	$81.72
Plasterers	5/1/2023		$31.33	$20.83	$52.16
plumber	5/1/2023		$52.48	$34.56	$87.04
Roofers (Composition)	5/1/2023		$42.63	$34.62	$77.25
Roofers (Shingle)	5/1/2020		$29.50	$21.25	$50.75
Roofers (Shingle)	5/1/2023		$32.85	$22.10	$54.95
Roofers (Slate & Tile)	5/1/2020		$32.50	$21.25	$53.75
Roofers (Slate & Tile)	5/1/2023		$35.85	$22.10	$57.95
Sheet Metal Workers	6/1/2022		$40.22	$41.01	$81.23
Sheet Metal Workers	6/1/2023		$41.41	$42.32	$83.73
Sign Makers and Hangars	7/15/2022		$30.54	$24.35	$54.89
Sign Makers and Hangars	7/15/2023		$31.76	$24.63	$56.39
Sprinklerfitters	4/1/2023		$44.33	$28.04	$72.37
Steamfitters	5/1/2023		$57.07	$41.99	$99.06
Terrazzo Finisher	5/1/2023		$35.79	$19.25	$55.04
Terrazzo Finisher	5/1/2024		$37.16	$19.26	$56.42
Terrazzo Grinder	5/1/2023		$36.54	$19.25	$55.79
Terrazzo Grinder	5/1/2024		$37.92	$19.26	$57.18

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-09259 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Terrazzo Mechanics	5/1/2023		$36.51	$21.00	$57.51
Terrazzo Mechanics	5/1/2024		$37.94	$21.01	$58.95
Tile & Marble Finisher	5/1/2023		$32.16	$16.24	$48.40
Tile & Marble Finisher	5/1/2024		$34.11	$16.24	$50.35
Tile & Marble Finisher	5/1/2025		$36.06	$16.24	$52.30
Tile & Marble Finisher	5/1/2026		$38.01	$16.24	$54.25
Tile Setter	5/1/2023		$35.81	$16.73	$52.54
Tile Setter	5/1/2024		$37.76	$16.73	$54.49
Tile Setter	5/1/2025		$39.71	$16.73	$56.44
Truckdriver class 1(see notes)	5/1/2021		$37.72	$0.00	$37.72
Truckdriver class 2 (see notes)	5/1/2021		$37.79	$0.00	$37.79
Truckdriver class 3 (see notes)	5/1/2021		$38.28	$0.00	$38.28
Window Film / Tint Installer	6/1/2019		$24.52	$12.08	$36.60

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-09259 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Carpenter - Chief of Party (Surveying & Layout)	5/1/2021		$41.42	$15.49	$56.91
Carpenter - Instrument Person (Surveying & Layout)	5/1/2021		$36.02	$15.49	$51.51
Carpenter - Rodman I (Survey & Layout)	5/1/2021		$28.82	$12.39	$41.21
Carpenter	5/1/2023		$35.32	$19.09	$54.41
Carpenter	5/1/2024		$36.12	$19.79	$55.91
Carpenter	5/1/2025		$36.87	$20.49	$57.36
Carpenter	5/1/2026		$37.63	$21.18	$58.81
Carpenter Welder	5/1/2023		$36.07	$19.09	$55.16
Carpenter Welder	5/1/2024		$36.87	$19.79	$56.66
Carpenter Welder	5/1/2025		$37.62	$20.49	$58.11
Carpenter Welder	5/1/2026		$38.38	$21.18	$59.56
Carpenters - Piledriver/Welder	1/1/2023		$36.07	$19.09	$55.16
Carpenters - Piledriver/Welder	1/1/2024		$36.87	$19.79	$56.66
Carpenters - Piledriver/Welder	1/1/2025		$37.62	$20.49	$58.11
Carpenters - Piledriver/Welder	1/1/2026		$38.38	$21.18	$59.56
Cement Finishers	1/1/2017		$27.70	$20.20	$47.90
Dockbuilder, Pile Drivers	5/1/2023		$50.48	$37.99	$88.47
Dockbuilder, Pile Drivers	5/1/2024		$52.98	$37.99	$90.97
Dockbuilder, Pile Drivers	5/1/2025		$55.23	$37.99	$93.22
Dockbuilder, Pile Drivers	5/1/2026		$56.98	$37.99	$94.97
Dockbuilder/Pile Driver Diver	5/1/2023		$58.41	$41.74	$100.15
Dockbuilder/Pile Driver Diver	5/1/2024		$61.54	$41.74	$103.28
Dockbuilder/Pile Driver Diver	5/1/2025		$64.35	$41.74	$106.09
Dockbuilder/Pile Driver Diver	5/1/2026		$66.54	$41.74	$108.28
Dockbuilder/pile driver tender	5/1/2023		$50.48	$37.99	$88.47
Dockbuilder/pile driver tender	5/1/2024		$52.98	$37.99	$90.97
Dockbuilder/pile driver tender	5/1/2025		$55.23	$37.99	$93.22
Dockbuilder/pile driver tender	5/1/2026		$56.98	$37.99	$94.97
Electric Lineman	5/30/2022		$50.28	$28.47	$78.75
Electric Lineman	5/29/2023		$51.40	$29.62	$81.02
Electric Lineman	6/3/2024		$52.80	$30.61	$83.41
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2021		$34.01	$31.13	$65.14
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2023		$36.26	$31.38	$67.64
Laborers (Class 01 - See notes)	5/1/2023		$24.81	$18.99	$43.80
Laborers (Class 01 - See notes)	5/1/2024		$25.61	$19.49	$45.10
Laborers (Class 02 - See notes)	5/1/2023		$31.43	$18.99	$50.42
Laborers (Class 02 - See notes)	5/1/2024		$32.23	$19.49	$51.72
Laborers (Class 03 - See notes)	5/1/2023		$28.42	$18.99	$47.41
Laborers (Class 03 - See notes)	5/1/2024		$29.22	$19.49	$48.71
Laborers (Class 04 - See notes)	5/1/2023		$28.77	$18.99	$47.76
Laborers (Class 04 - See notes)	5/1/2024		$29.57	$19.49	$49.06
Laborers (Class 05 - See notes)	5/1/2023		$29.44	$18.99	$48.43
Laborers (Class 05 - See notes)	5/1/2024		$30.24	$19.49	$49.73

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-09259 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 06 - See notes)	5/1/2023		$28.86	$18.99	$47.85
Laborers (Class 06 - See notes)	5/1/2024		$29.66	$19.49	$49.15
Laborers (Class 07 - See notes)	5/1/2023		$29.15	$18.99	$48.14
Laborers (Class 07 - See notes)	5/1/2024		$29.95	$19.49	$49.44
Laborers (Class 08 - See notes)	5/1/2023		$29.63	$18.99	$48.62
Laborers (Class 08 - See notes)	5/1/2024		$30.43	$19.49	$49.92
Millwright	6/1/2023		$41.51	$23.33	$64.84
Millwright	6/1/2024		$43.46	$23.33	$66.79
Millwright	6/1/2025		$45.46	$23.33	$68.79
Millwright	6/1/2026		$47.52	$23.33	$70.85
Operators (Heavy, Class 01 - See Notes)	5/1/2023		$41.14	$28.82	$69.96
Operators (Heavy, Class 01 - See Notes)	5/1/2024		$42.30	$29.66	$71.96
Operators (Heavy, Class 01 - See Notes)	5/1/2025		$43.46	$30.50	$73.96
Operators (Heavy, Class 01 - See Notes)	5/1/2026		$44.61	$31.35	$75.96
Operators (Heavy, Class 01A - See Notes)	5/1/2023		$43.39	$29.48	$72.87
Operators (Heavy, Class 01A - See Notes)	5/1/2024		$44.55	$30.32	$74.87
Operators (Heavy, Class 01A - See Notes)	5/1/2025		$45.71	$31.16	$76.87
Operators (Heavy, Class 01A - See Notes)	5/1/2026		$46.86	$32.01	$78.87
Operators (Heavy, Class 02 - See Notes)	5/1/2023		$40.86	$28.73	$69.59
Operators (Heavy, Class 02 - See Notes)	5/1/2024		$42.02	$29.57	$71.59
Operators (Heavy, Class 02 - See Notes)	5/1/2025		$43.18	$30.41	$73.59
Operators (Heavy, Class 02 - See Notes)	5/1/2026		$44.34	$31.25	$75.59
Operators (Heavy, Class 02A - See Notes)	5/1/2023		$43.11	$29.40	$72.51
Operators (Heavy, Class 02A - See Notes)	5/1/2024		$44.27	$30.24	$74.51
Operators (Heavy, Class 02A - See Notes)	5/1/2025		$45.43	$31.08	$76.51
Operators (Heavy, Class 02A - See Notes)	5/1/2026		$46.59	$31.92	$78.51
Operators (Heavy, Class 03 - See Notes)	5/1/2023		$37.95	$27.86	$65.81
Operators (Heavy, Class 03 - See Notes)	5/1/2024		$39.11	$28.70	$67.81
Operators (Heavy, Class 03 - See Notes)	5/1/2025		$40.26	$29.55	$69.81
Operators (Heavy, Class 03 - See Notes)	5/1/2026		$41.43	$30.38	$71.81
Operators (Heavy, Class 04 - See Notes)	5/1/2023		$36.80	$27.54	$64.34
Operators (Heavy, Class 04 - See Notes)	5/1/2024		$37.96	$28.38	$66.34
Operators (Heavy, Class 04 - See Notes)	5/1/2025		$39.12	$29.22	$68.34
Operators (Heavy, Class 04 - See Notes)	5/1/2026		$40.28	$30.06	$70.34
Operators (Heavy, Class 05 - See Notes)	5/1/2023		$36.35	$27.41	$63.76
Operators (Heavy, Class 05 - See Notes)	5/1/2024		$37.51	$28.25	$65.76
Operators (Heavy, Class 05 - See Notes)	5/1/2025		$38.67	$29.09	$67.76
Operators (Heavy, Class 05 - See Notes)	5/1/2026		$39.83	$29.93	$69.76
Operators (Heavy, Class 06 - See Notes)	5/1/2023		$35.48	$27.14	$62.62
Operators (Heavy, Class 06 - See Notes)	5/1/2024		$36.64	$27.98	$64.62
Operators (Heavy, Class 06 - See Notes)	5/1/2025		$37.80	$28.82	$66.62
Operators (Heavy, Class 06 - See Notes)	5/1/2026		$38.96	$29.66	$68.62
Operators (Heavy, Class 07A - See Notes)	5/1/2023		$49.93	$32.83	$82.76
Operators (Heavy, Class 07A - See Notes)	5/1/2024		$51.39	$33.77	$85.16

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-09259 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Heavy, Class 07A - See Notes)	5/1/2025		$52.85	$34.71	$87.56
Operators (Heavy, Class 07A - See Notes)	5/1/2026		$54.32	$35.64	$89.96
Operators (Heavy, Class 07B - See Notes)	5/1/2023		$49.58	$32.73	$82.31
Operators (Heavy, Class 07B - See Notes)	5/1/2024		$51.04	$33.67	$84.71
Operators (Heavy, Class 07B - See Notes)	5/1/2025		$52.51	$34.60	$87.11
Operators (Heavy, Class 07B - See Notes)	5/1/2026		$53.97	$35.54	$89.51
Operators (Highway, Class 01 - See Notes)	5/1/2023		$40.25	$28.55	$68.80
Operators (Highway, Class 01 - See Notes)	5/1/2024		$41.41	$29.39	$70.80
Operators (Highway, Class 01 - See Notes)	5/1/2025		$42.56	$30.24	$72.80
Operators (Highway, Class 01 - See Notes)	5/1/2026		$43.72	$31.08	$74.80
Operators (Highway, Class 01a - See Notes)	5/1/2023		$42.50	$29.23	$71.73
Operators (Highway, Class 01a - See Notes)	5/1/2024		$43.66	$30.07	$73.73
Operators (Highway, Class 01a - See Notes)	5/1/2025		$44.81	$30.92	$75.73
Operators (Highway, Class 01a - See Notes)	5/1/2026		$45.97	$31.76	$77.73
Operators (Highway, Class 02 - See Notes)	5/1/2023		$39.08	$28.20	$67.28
Operators (Highway, Class 02 - See Notes)	5/1/2024		$40.24	$29.04	$69.28
Operators (Highway, Class 02 - See Notes)	5/1/2025		$41.39	$29.89	$71.28
Operators (Highway, Class 02 - See Notes)	5/1/2026		$42.55	$30.73	$73.28
Operators (Highway, Class 03 - See Notes)	5/1/2023		$38.39	$27.99	$66.38
Operators (Highway, Class 03 - See Notes)	5/1/2024		$39.55	$28.83	$68.38
Operators (Highway, Class 03 - See Notes)	5/1/2025		$40.70	$29.68	$70.38
Operators (Highway, Class 03 - See Notes)	5/1/2026		$41.87	$30.51	$72.38
Operators (Highway, Class 04 - See Notes)	5/1/2023		$37.94	$27.86	$65.80
Operators (Highway, Class 04 - See Notes)	5/1/2024		$39.10	$28.70	$67.80
Operators (Highway, Class 04 - See Notes)	5/1/2025		$40.26	$29.54	$69.80
Operators (Highway, Class 04 - See Notes)	5/1/2026		$41.41	$30.39	$71.80
Operators (Highway, Class 05 - See Notes)	5/1/2023		$37.42	$27.72	$65.14
Operators (Highway, Class 05 - See Notes)	5/1/2024		$38.58	$28.56	$67.14
Operators (Highway, Class 05 - See Notes)	5/1/2025		$39.73	$29.41	$69.14
Operators (Highway, Class 05 - See Notes)	5/1/2026		$40.89	$30.25	$71.14
Operators (Highway, Class 06 - See Notes)	5/1/2023		$40.48	$28.62	$69.10
Operators (Highway, Class 06 - See Notes)	5/1/2024		$41.64	$29.46	$71.10
Operators (Highway, Class 06 - See Notes)	5/1/2025		$42.80	$30.30	$73.10
Operators (Highway, Class 06 - See Notes)	5/1/2026		$43.95	$31.15	$75.10
Operators (Highway, Class 06/A - See Notes)	5/1/2023		$42.73	$29.28	$72.01
Operators (Highway, Class 06/A - See Notes)	5/1/2024		$43.89	$30.12	$74.01
Operators (Highway, Class 06/A - See Notes)	5/1/2025		$45.05	$30.96	$76.01
Operators (Highway, Class 06/A - See Notes)	5/1/2026		$46.21	$31.80	$78.01
Operators (Highway, Class 07/A - See Notes)	5/1/2023		$48.86	$32.51	$81.37
Operators (Highway, Class 07/A - See Notes)	5/1/2024		$50.32	$33.45	$83.77
Operators (Highway, Class 07/A - See Notes)	5/1/2025		$51.79	$34.38	$86.17
Operators (Highway, Class 07/A - See Notes)	5/1/2026		$53.25	$35.32	$88.57
Operators (Highway, Class 07/B - See Notes)	5/1/2023		$47.44	$32.10	$79.54
Operators (Highway, Class 07/B - See Notes)	5/1/2024		$48.91	$33.03	$81.94

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-09259 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Highway, Class 07/B - See Notes)	5/1/2025		$50.37	$33.97	$84.34
Operators (Highway, Class 07/B - See Notes)	5/1/2026		$51.84	$34.90	$86.74
Painters Class 2 (see notes)	5/1/2023		$33.99	$23.20	$57.19
Painters Class 3 (see notes)	5/1/2023		$40.09	$23.20	$63.29
Piledrivers	5/1/2023		$35.32	$19.09	$54.41
Piledrivers	5/1/2024		$36.12	$19.79	$55.91
Piledrivers	5/1/2025		$36.87	$20.49	$57.36
Piledrivers	5/1/2026		$37.63	$21.18	$58.81
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2022		$48.43	$40.28	$88.71
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2023		$50.53	$41.68	$92.21
Truckdriver class 1(see notes)	5/1/2021		$37.72	$0.00	$37.72
Truckdriver class 2 (see notes)	5/1/2021		$37.79	$0.00	$37.79
Truckdriver class 3 (see notes)	5/1/2021		$38.28	$0.00	$38.28

Owners Documents - Instructions to Bidders

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1. CONTRACT DOCUMENTS

   A. The Contract Documents may be obtained as noted in the Advertisement for Bids.

2. EXAMINATION

   A. Bidders must review and conform to the INSTRUCTIONS TO BIDDERS, and examine each of the Contract Documents that form the Contract, become thoroughly familiar with the Drawings and Specifications, visit the location of the work, fully inform themselves of the existing conditions, and make their own estimate of the available facilities and difficulties attending the execution of the Work.

3. QUESTIONS

   A. Should the Bidder detect any potential discrepancies, conflicts, errors or omissions in the Drawings, Specifications, or other Contract Documents, or should he be in doubt as to their meaning, he should at once notify the Engineer. All questions must be submitted to the Engineer via PennBid's "Question" tab. Questions received less than seven (7) days prior to the date of Bid opening, will not be considered. No oral answers or interpretations will be provided. Answers to questions may or may not be issued as addenda. Any Addenda issued shall become a part of the Contract. The Engineer will post each Addendum within PennBid's "Documents" section and email a notice to all landholders at the time the Addendum is issued.

4. QUALIFICATIONS OF BIDDERS

   A. It is the purpose of the Owner to award this Contract only to a Bidder who has furnished satisfactory evidence that he has the ability and specific experience in this class of work, and that he has sufficient capital and plant to enable him to prosecute the same successfully, and to complete it in the specified time. The Owner's decision or judgment on these matters shall be final, conclusive and binding.

   B. The Owner may make such investigations as he deems necessary to determine the ability of the Bidder to perform the Work.

5. INFORMATION NOT GUARANTEED

   A. All information relating to existing subsurface structures and/or underground facilities, pipes or other utilities is from the best sources presently available to the Owner. All such information and the drawings of existing construction are furnished only for the information and convenience of Bidders.

   B. It is agreed and understood that the Owner does not warrant or guarantee that the subsurface structures and/or underground facilities, pipes or other utilities encountered during construction will be the same as those indicated by the information given on the Drawings or in the Specifications.

   C. The Bidder is responsible for ascertaining the character, quantities, and conditions of the various materials and the work to be done.

D. During construction the Contractor shall either dig test holes to determine the position of the underground structures and utilities, or he shall arrange with the owners of such underground structures and utilities to assign a representative to mark the locations. The Contractor shall at his own expense pay the cost of digging test holes; the cost of the services of the representatives of the owners of such utilities for locating the said utilities; and the cost of determining the locations.

E. It is further agreed and understood that the Bidder or the Contractor will not use any of the information made available to him or obtained in any examination made by him in any manner as a basis or ground of claim or demand of any nature, against the Owner or the Engineer, arising from or by reason of any variance which may exist between the information offered and the actual materials or structures encountered during the construction work, except as may otherwise be provided for in the Contract Documents.

6. SUBSTITUTION

A. In the various detailed sections of the Specifications, where any item of equipment or material is specified by proprietary name, trade name, and/or name of one or more manufacturers, without the addition of such expressions as "or equal", it is to be understood that those items are so specified for reasons of standardization in maintenance and operation, or is intended for obtaining desirable features best suited to the requirements of the Specifications.

B. In the various detailed sections of the Specifications, where any item of equipment or material is specified by proprietary name, trade name, and/or name of one or more manufacturers, with the addition of such expression as "or equal", it is to be understood that equal quality equipment or products of either a manufacturer named or of a manufacturer not named, which meets the detailed requirements of the Specifications, is intended, subject to the review by the Engineer as to the equality thereof, and it is distinctly understood that:

1. The Architect is to use his own judgment in determining whether or not any item of equipment or material proposed is equal in quality to that specified.

2. The decision of the Architect on all such questions of equality shall be final.

3. In the event of any adverse decision by the Architect, no claim of any sort shall be made or allowed against the Architect or the Owner.

7. PREPARATION OF BIDS

A. Each Bid must be submitted electronically via PennBid's "Bid" tab. Bidders may update their bids at any time prior to the bid due date and time. Bidders shall also electronically submit additional documents as noted in the Bidders Checklist, or as specified elsewhere.

Provide with the Bid, the Names and Federal Employer Identification Numbers of the Contractor and all subcontractors that will work on this project.

8. BASIS OF BID

A. The Bidder must include all lump sum and unit cost items shown on the Bid forms. No segregated Bids or assignments will be considered. Bidder must follow and comply with all instructions and directions as noted on the “Bid” tab.

9. BID SECURITY

A. Each Bid must be accompanied by Bid Security in the form of a Bid Bond (on the form included herein) or a Certified Check. Bid Security shall be made payable to the OWNER, addressed as defined in the Bid Form. The form of Bid Security acceptable to the OWNER, and the required amount of such security is stated in the Advertisement for Bids. The Bid Bond Form must be executed by a Surety licensed to conduct business in the State where the work is located. The actual Certified Check must be received by BCM Engineers before the end of the next business day after the bids were received or the Bid may be considered as non-responsive.

B. Such checks will be returned to all except the three lowest Bidders, within ten (10) days after the bid opening. The checks of such three Bidders will be returned within five (5) days after the successful Bidder and Owner have executed the Contract and Contractor has furnished acceptable Performance and Payment Bonds, or until ninety (90) days as provided in Paragraph 15, A after the bid opening, whichever is earlier. If requested by the Bidder in writing, Bid Bonds will be returned as outlined above.

C. If any Bidder refuses to enter into a Contract, the Owner will retain his Bid Security as liquidated damages, but not as a penalty. The Bid Security is to be submitted with the submission of Bids.

D. Attorneys-In-Fact who sign Bid Bonds must file with each Bond a certified copy of their "Power of Attorney" to sign said Bonds signed by an officer of the Surety, and they must also file a Financial Statement of the Surety Company.

10. BONDS

A. Each Bidder must accompany his Bid with a properly signed certificate from his Surety Company indicating that such Surety Company will provide the Bidder, if awarded the Contract, with a proper Performance Bond and Labor and Material Payment Bond covering up to the full amount of the Contract Price as security for the faithful performance of all work under the Contract and payment of all charges in connection therewith. The Bonds shall be prepared on the forms attached hereto and must be furnished prior to award of the Contract.

1. The Surety Company must be on the current United States Department of the Treasury Fiscal Service listing, be acceptable to the Owner and authorized to transact business in the State where the Work is located.

11. COMMENCEMENT AND COMPLETION

A. Work at the job site shall be commenced within ten (10) calendar days following receipt of Notice to Proceed. The time of completion shall be the number of consecutive calendar days stated in the Bid Form, and this time shall begin with the date indicated in the Notice to Proceed. The order of the Engineer to proceed with the Work shall be given within thirty (30) calendar days following full execution of the Contract Agreement.

12. LIQUIDATED DAMAGES

A. Should a Contractor fail to complete his work on or before the time set forth above or as provided in the Contract Documents covering extension of time, then the Owner may retain an amount as set forth in the Bid Form as liquidated damages for each calendar day in accordance with the provisions of that section.

13. Not Used.

14. BID SUBMISSION

A. All bids must be submitted online via the PennBid Program. Refer to *PennBid – Instructions to Bidders* document for additional details. Any and all bids submitted in any manner other than via PennBid online will be considered non-responsive and will be rejected.

15. WITHDRAWAL OF BIDS

A. The attention of Bidders is directed to the fact that in submitting his Proposal, the Bidder agrees, except as noted below, that he will not withdraw it within ninety (90) days of the date of Bid opening, provided that, if the award is delayed by a required approval of another government agency, the sale of Bonds, or the award of a grant or grants, such Bids shall not be withdrawn within 120 days, after the actual date of the opening of Bids.

B. Upon proper request and identification, Bids may be withdrawn as follows:

1. At any time prior to the designated time for the opening of Bids.

2. In accordance with Act No. 4 of the 1974 title "Public Contracts-Bids Withdrawal" of the Commonwealth of Pennsylvania.

C. Unless a Proposal is formally withdrawn, it shall be deemed open for acceptance until the Contract Agreement has been executed by both parties thereto or until the Owner indicates in writing that he does not intend to accept the Proposal. Notice of acceptance of a Proposal shall not constitute rejection of any other Proposal.

16. MODIFICATION OF BIDS

A. Bidder may modify and resubmit his bid any time prior to bid opening.

17. DISQUALIFICATION

A. The Owner reserves the right to disqualify Bids, before or after opening, upon evidence of collusion with intent to defraud, or other illegal practices on the part of the Bidder.

18. GOVERNING LAWS AND REGULATIONS

A. PENNSYLVANIA PREVAILING WAGE ACT NO. 442

1. Every Contractor and Subcontractor must abide by the requirements of Act No. 442 of Pennsylvania Department of Labor and Industry, and conform to the applicable Determination made by the Secretary of the Department of Labor & Industry as to the Prevailing Minimum Wage Rates in the locality where this Contract is to be constructed. This Wage Determination is made an integral part of these Specifications and is included herein.

2. The Contractor shall post the hereinafter contained minimum wage rates, include the effective date of any changes thereof, in prominent and easily accessible places on the site of the work, or at such place or places as are used by the Contractor to pay workmen their wages.

3. Before final payment will be made, Contractor and his Subcontractor shall file statements in writing with the Secretary certifying to the amounts then due and owing, from such Contractor and Subcontractor filing such statement, to any and all workmen, setting forth therein the names of persons whose wages are unpaid and the amount due to each respectively, which statement so to be filed shall be verified by the oath of the Contractor and Subcontractor, as the case may be, that he has read such statement subscribed by him, knows the contents thereof and that the same is true of his own knowledge.

B. Sales and Use Taxes

1. The Bidder shall study all tax laws for the jurisdiction in which the work is done, particularly so-called "Sales and Use Taxes" for which he is liable as a consumer or user of goods. The Bid shall be made in accordance with such laws and shall include such taxes in the Bid amount. The Bidder shall also obtain, where applicable, sales and use tax exemptions. In no event shall the Owner be directly responsible for any sales or use taxes.

19. STEEL PRODUCTS PROCUREMENT ACT

A. The Contractor is referred to Pennsylvania Act No. 1978, P.L. 6, No. 3, known as the "STEEL PRODUCTS PROCUREMENT ACT" as amended. This act shall apply to all contracts for construction, reconstruction, alteration, repair, improvement or maintenance of public work which is performed for a public agency within the Commonwealth of Pennsylvania.

B. Under this act, if any steel products are to be used in the performance of this project only steel products produced in the United States or its territories shall be used.

C. U.S. Steel is defined as all steel products rolled, formed shaped, drawn, extruded, forged, cast fabricated or otherwise similarly processed, or processed by a combination of two or more of such operations, from steel made in the United States by the open hearth, basic oxygen, electric furnace, Bessemer or other steel making process, and shall include cast iron products.

D. This Act also prohibits payments under the Contract unless the public agency is satisfied that the Contractor has fully complied with the Act.

20. Not Used.

21. Not Used.

22. Not Used.

23. OPENING

A. Bids will be opened at the time and place as stated in the Advertisement for Bids.

24. AWARD

A. If the Contract will be awarded, it will be awarded to the lowest responsive and responsible Bidder for the Base Bid work to be done, including full consideration of lump sum and unit prices, and in accordance with the Advertisement For Bids.

25. EXECUTION OF CONTRACT

A. The Owner reserves the right to accept any Bid, and to reject any and all Bids, when such is deemed by the Owner to be in his best interest.

B. The apparent low Bidder shall execute the formal Contract Agreement, furnish the required Surety Bonds and Insurance Certificates and return them to the Engineer within ten (10) calendar days following receipt.

C. Each Bidder shall be prepared to commence work within ten (10) calendar days following receipt of official written order of the Engineer to proceed or on date stipulated in such order.

** END OF SECTION **

Labor and Material Bond – General Building Construction 1A

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____

(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____

(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 1A - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall promptly make payment to all CLAIMANTS as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the CONTRACT, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1) A CLAIMANT is defined as one having a direct contract with the PRINCIPAL or with a SUBCONTRACTOR of the PRINCIPAL for labor, material, or both, used or reasonably required for use in the performance of the CONTRACT, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the CONTRACT.

2) The above named PRINCIPAL and SURETY hereby jointly and severally agree with the OWNER that every CLAIMANT as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such CLAIMANT'S work or labor was done or performed, or materials were furnished by such CLAIMANT, may sue on this BOND for the use of such CLAIMANT, prosecute the suit to final judgment for such sums as may be justly due CLAIMANT, and have execution thereon. The OWNER shall not be liable for the payment of any costs or expenses of any such suit.

3) No such suit or action shall be commenced hereunder by any CLAIMANT.

   a) Unless CLAIMANT, other than one having a direct contract with the PRINCIPAL, shall have given written notice to the PRINCIPAL, OWNER and SURETY, within (90) days after such CLAIMANT did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the PRINCIPAL, OWNER, and SURETY, at any place where an office is regularly maintained for the transaction of the business, or served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

   b) After the expiration of one (1) year following the date on which PRINCIPAL ceased work on said CONTRACT, it being under- stood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

4) The amount of this BOND shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by SURETY of mechanics' liens which may be filed of record against such improvement, whether or not claim for the amount of such lien be presented under and against this BOND.

5) The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK may be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT, shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waive notice of any alterations, changes, additions, extensions of time, act of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Labor and Material Bond – Mechanical Construction 15A

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____

(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____

(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 15A - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall promptly make payment to all CLAIMANTS as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the CONTRACT, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1) A CLAIMANT is defined as one having a direct contract with the PRINCIPAL or with a SUBCONTRACTOR of the PRINCIPAL for labor, material, or both, used or reasonably required for use in the performance of the CONTRACT, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the CONTRACT.

2) The above named PRINCIPAL and SURETY hereby jointly and severally agree with the OWNER that every CLAIMANT as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such CLAIMANT'S work or labor was done or performed, or materials were furnished by such CLAIMANT, may sue on this BOND for the use of such CLAIMANT, prosecute the suit to final judgment for such sums as may be justly due CLAIMANT, and have execution thereon. The OWNER shall not be liable for the payment of any costs or expenses of any such suit.

3) No such suit or action shall be commenced hereunder by any CLAIMANT.

   a) Unless CLAIMANT, other than one having a direct contract with the PRINCIPAL, shall have given written notice to the PRINCIPAL, OWNER and SURETY, within (90) days after such CLAIMANT did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the PRINCIPAL, OWNER, and SURETY, at any place where an office is regularly maintained for the transaction of the business, or served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

   b) After the expiration of one (1) year following the date on which PRINCIPAL ceased work on said CONTRACT, it being under- stood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

4) The amount of this BOND shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by SURETY of mechanics' liens which may be filed of record against such improvement, whether or not claim for the amount of such lien be presented under and against this BOND.

5) The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK may be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT, shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waive notice of any alterations, changes, additions, extensions of time, act of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Labor and Material Bond – Plumbing Construction 15B

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____

(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____

(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 15B - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall promptly make payment to all CLAIMANTS as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the CONTRACT, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1) A CLAIMANT is defined as one having a direct contract with the PRINCIPAL or with a SUBCONTRACTOR of the PRINCIPAL for labor, material, or both, used or reasonably required for use in the performance of the CONTRACT, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the CONTRACT.

2) The above named PRINCIPAL and SURETY hereby jointly and severally agree with the OWNER that every CLAIMANT as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such CLAIMANT'S work or labor was done or performed, or materials were furnished by such CLAIMANT, may sue on this BOND for the use of such CLAIMANT, prosecute the suit to final judgment for such sums as may be justly due CLAIMANT, and have execution thereon. The OWNER shall not be liable for the payment of any costs or expenses of any such suit.

3) No such suit or action shall be commenced hereunder by any CLAIMANT.

   a) Unless CLAIMANT, other than one having a direct contract with the PRINCIPAL, shall have given written notice to the PRINCIPAL, OWNER and SURETY, within (90) days after such CLAIMANT did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the PRINCIPAL, OWNER, and SURETY, at any place where an office is regularly maintained for the transaction of the business, or served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

   b) After the expiration of one (1) year following the date on which PRINCIPAL ceased work on said CONTRACT, it being under- stood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

4) The amount of this BOND shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by SURETY of mechanics' liens which may be filed of record against such improvement, whether or not claim for the amount of such lien be presented under and against this BOND.

5) The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK may be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT, shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waive notice of any alterations, changes, additions, extensions of time, act of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Labor and Material Bond – Electrical Construction 16A

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____
(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____
(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 16A - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall promptly make payment to all CLAIMANTS as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the CONTRACT, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1) A CLAIMANT is defined as one having a direct contract with the PRINCIPAL or with a SUBCONTRACTOR of the PRINCIPAL for labor, material, or both, used or reasonably required for use in the performance of the CONTRACT, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the CONTRACT.

2) The above named PRINCIPAL and SURETY hereby jointly and severally agree with the OWNER that every CLAIMANT as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such CLAIMANT'S work or labor was done or performed, or materials were furnished by such CLAIMANT, may sue on this BOND for the use of such CLAIMANT, prosecute the suit to final judgment for such sums as may be justly due CLAIMANT, and have execution thereon. The OWNER shall not be liable for the payment of any costs or expenses of any such suit.

3) No such suit or action shall be commenced hereunder by any CLAIMANT.

   a) Unless CLAIMANT, other than one having a direct contract with the PRINCIPAL, shall have given written notice to the PRINCIPAL, OWNER and SURETY, within (90) days after such CLAIMANT did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the PRINCIPAL, OWNER, and SURETY, at any place where an office is regularly maintained for the transaction of the business, or served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

   b) After the expiration of one (1) year following the date on which PRINCIPAL ceased work on said CONTRACT, it being under- stood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

4) The amount of this BOND shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by SURETY of mechanics' liens which may be filed of record against such improvement, whether or not claim for the amount of such lien be presented under and against this BOND.

5) The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK may be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT, shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waive notice of any alterations, changes, additions, extensions of time, act of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Maintenance Bond General Building Construction 1A - Paving

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____
(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____
(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 1A - CUMRU FIRE DEPARTMENT - PAVING

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

That if the above bounden PRINCIPAL shall remedy without cost to the said OBLIGEE any defects which may develop during a period of two (2) year(s) for all paving work from _____, the date of completion and acceptance of the WORK performed under said CONTRACT provided such defects in the judgment of the OBLIGEE, or its successors having jurisdiction in the premises are caused by defective or inferior materials or workmanship, then Bond shall be void, otherwise the Bond shall be and remain in full force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the

CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS and by the CONTRACT shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns from liability under this BOND and the SURETY for value received does waive notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

(Business Address)

By

(Affix Corporate Seal)

Maintenance Bond – General Building Construction 1A

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____
(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____
(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 1A - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

That if the above bounden PRINCIPAL shall remedy without cost to the said OBLIGEE any defects which may develop during a period of one (1) year(s) for all work from _____, the date of completion and acceptance of the WORK performed under said CONTRACT provided such defects in the judgment of the OBLIGEE, or its successors having jurisdiction in the premises are caused by defective or inferior materials or workmanship, then Bond shall be void, otherwise the Bond shall be and remain in full force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the

PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS and by the CONTRACT shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns from liability under this BOND and the SURETY for value received does waive notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____

(Business Address)

By

(Affix Corporate Seal)

Maintenance Bond – Mechanical Construction 15A

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____
(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____
(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 15A - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

That if the above bounden PRINCIPAL shall remedy without cost to the said OBLIGEE any defects which may develop during a period of one (1) year(s) for all work from _____, the date of completion and acceptance of the WORK performed under said CONTRACT provided such defects in the judgment of the OBLIGEE, or its successors having jurisdiction in the premises are caused by defective or inferior materials or workmanship, then Bond shall be void, otherwise the Bond shall be and remain in full force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the

PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS and by the CONTRACT shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns from liability under this BOND and the SURETY for value received does waive notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____

(Business Address)

By

(Affix Corporate Seal)

Maintenance Bond – Plumbing Construction 15B

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____
(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____
(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 15B - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

That if the above bounden PRINCIPAL shall remedy without cost to the said OBLIGEE any defects which may develop during a period of one (1) year(s) for all work from _____, the date of completion and acceptance of the WORK performed under said CONTRACT provided such defects in the judgment of the OBLIGEE, or its successors having jurisdiction in the premises are caused by defective or inferior materials or workmanship, then Bond shall be void, otherwise the Bond shall be and remain in full force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the

PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS and by the CONTRACT shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns from liability under this BOND and the SURETY for value received does waive notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____

(Business Address)

By

(Affix Corporate Seal)

Maintenance Bond – Electrical Construction 16A

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____

(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____

(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, for the use and benefit of CLAIMANTS as herein below defined, in the full and just several sums of _____

_____DOLLARS ($_____) lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said OBLIGEE, dated _____, 20___, (hereinafter called the CONTRACT) for the Work under

CONTRACT NO. 16A - CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part hereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

That if the above bounden PRINCIPAL shall remedy without cost to the said OBLIGEE any defects which may develop during a period of one (1) year(s) for all work from _____, the date of completion and acceptance of the WORK performed under said CONTRACT provided such defects in the judgment of the OBLIGEE, or its successors having jurisdiction in the premises are caused by defective or inferior materials or workmanship, then Bond shall be void, otherwise the Bond shall be and remain in full force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the

PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS and by the CONTRACT shall not release in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns from liability under this BOND and the SURETY for value received does waive notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

NOTE: This Bond is executed and delivered under and subject to the provisions of Act No. 385 of the Pennsylvania General Assembly, approved December 20, 1967, and known as the Public Works Contractor's Bond Law of 1967.

IN WITNESS WHEREOF, the PRINCIPAL and SURETY have executed this instrument under their several seals this _____day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its proper officers, pursuant to authority of its governing body.

In presence of:

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

_____(SEAL)
(Individual or Partnership Principal)

_____
(Address) (Business Address)

Witness: _____

Attest:

_____
(Corporate Principal)

_____
(Business Address)

_____ By _____
(Affix Corporate Seal)

Attest:

_____
(Corporate Surety)

_____

(Business Address)

By

(Affix Corporate Seal)

NON-COLLUSION AFFIDAVIT – General Building Construction 1A

COMMONWEALTH OF PENNSYLVANIA ss: Township of Cumru
Contract No. 1A

COUNTY OF BERKS

I,_____ of _____, in the County of _____and the State of _____, of full age, being duly sworn according to law on my oath depose and say that:

I am of the firm of _____ the Bidder making the Proposal for the above named project, and that I executed the said Proposal with full authority so to do; that said Bidder has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive Bidding in connection with the above named project; and that all statements contained in said Proposal and in this affidavit are true and correct, and made with full knowledge that the Township of Cumru relies upon the truth of the statements contained in said Proposal and in the statements contained in this affidavit in awarding the contract for the said project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure such contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, except bona fide employees or bona fide established commercial or selling agencies maintained by

_____.
(Name of Contractor)

_____.
(Also type or print full name of affiant whose signature appears above)

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

_____
Notary Public

My commission expires _____ , 20__ .

NON-COLLUSION AFFIDAVIT – Mechanical Construction 15A

COMMONWEALTH OF PENNSYLVANIA ss: Township of Cumru
Contract No. 15A

COUNTY OF BERKS

I,_____ of _____, in the County of _____and the State of _____, of full age, being duly sworn according to law on my oath depose and say that:

I am of the firm of _____ the Bidder making the Proposal for the above named project, and that I executed the said Proposal with full authority so to do; that said Bidder has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive Bidding in connection with the above named project; and that all statements contained in said Proposal and in this affidavit are true and correct, and made with full knowledge that the Township of Cumru relies upon the truth of the statements contained in said Proposal and in the statements contained in this affidavit in awarding the contract for the said project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure such contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, except bona fide employees or bona fide established commercial or selling agencies maintained by

_____.
(Name of Contractor)

_____.
(Also type or print full name of affiant whose signature appears above)

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

_____
Notary Public

My commission expires _____ , 20__ .

NON-COLLUSION AFFIDAVIT – Plumbing Construction 15B

COMMONWEALTH OF PENNSYLVANIA ss: Township of Cumru
Contract No. 15B

COUNTY OF BERKS

I,_____ of _____, in the County of _____and the State of _____, of full age, being duly sworn according to law on my oath depose and say that:

I am of the firm of _____ the Bidder making the Proposal for the above named project, and that I executed the said Proposal with full authority so to do; that said Bidder has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive Bidding in connection with the above named project; and that all statements contained in said Proposal and in this affidavit are true and correct, and made with full knowledge that the Township of Cumru relies upon the truth of the statements contained in said Proposal and in the statements contained in this affidavit in awarding the contract for the said project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure such contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, except bona fide employees or bona fide established commercial or selling agencies maintained by

_____.
(Name of Contractor)

_____.
(Also type or print full name of affiant whose signature appears above)

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

_____
Notary Public

My commission expires _____ , 20__ .

NON-COLLUSION AFFIDAVIT – Electrical Construction 16A

COMMONWEALTH OF PENNSYLVANIA ss: Township of Cumru
Contract No. 16A

COUNTY OF BERKS

I,_____ of _____, in the County of _____and the State of _____, of full age, being duly sworn according to law on my oath depose and say that:

I am of the firm of _____ the Bidder making the Proposal for the above named project, and that I executed the said Proposal with full authority so to do; that said Bidder has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive Bidding in connection with the above named project; and that all statements contained in said Proposal and in this affidavit are true and correct, and made with full knowledge that the Township of Cumru relies upon the truth of the statements contained in said Proposal and in the statements contained in this affidavit in awarding the contract for the said project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure such contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, except bona fide employees or bona fide established commercial or selling agencies maintained by

_____.
(Name of Contractor)

_____.
(Also type or print full name of affiant whose signature appears above)

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

_____
Notary Public

My commission expires _____ , 20__ .

Performance Bond – General Building Construction 1A

KNOW ALL MEN BY THESE PRESENTS,

That we the undersigned _____

_____

(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____

(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto the Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, in full and just several sums of _____

_____

DOLLARS ($_____)
lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said

OBLIGEE, dated _____, 20____, (hereinafter called the CONTRACT) for

Contract No. 1A – CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part thereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall well, truly and faithfully comply with and perform the CONTRACT in accordance with the CONTRACT DOCUMENTS, at time and in the manner provided in the CONTRACT and in the CONTRACT DOCUMENTS, and if the PRINCIPAL shall satisfy all claims and demands incurred in or related to the performance of the CONTRACT by the PRINCIPAL or growing out of the performance of the CONTRACT by the PRINCIPAL and if the PRINCIPAL shall indemnify completely and shall save harmless the OBLIGEE from any and all costs and damages which the OBLIGEE may sustain or suffer by reason of failure of the PRINCIPAL to do so, and if the PRINCIPAL shall reimburse completely and shall pay to the OBLIGEE any and all costs and expenses which the OBLIGEE may incur by reason of any such default or failure of the PRINCIPAL, then this BOND shall be void; otherwise, this BOND shall be and shall remain in force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes, or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS, and by the CONTRACT, shall not release, in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waiver notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

PROVIDED, FURTHER, this instrument is subject to the provisions of the Act of the General Assembly of the Commonwealth of Pennsylvania approved December 20, 1967, P.L. 869, 8 P.S. Section 191 et seq., known as "Public Works Contractors' Bond Law of 1967".

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Performance Bond – Mechanical Construction 15A

KNOW ALL MEN BY THESE PRESENTS,

That we the undersigned_____

_____

(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____

(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto the Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, in full and just several sums of _____

_____

DOLLARS ($_____)
lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said

OBLIGEE, dated _____, 20____, (hereinafter called the CONTRACT) for

Contract No. 15A – CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part thereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall well, truly and faithfully comply with and perform the CONTRACT in accordance with the CONTRACT DOCUMENTS, at time and in the manner provided in the CONTRACT and in the CONTRACT DOCUMENTS, and if the PRINCIPAL shall satisfy all claims and demands incurred in or related to the performance of the CONTRACT by the PRINCIPAL or growing out of the performance of the CONTRACT by the PRINCIPAL and if the PRINCIPAL shall indemnify completely and shall save harmless the OBLIGEE from any and all costs and damages which the OBLIGEE may sustain or suffer by reason of failure of the PRINCIPAL to do so, and if the PRINCIPAL shall reimburse completely and shall pay to the OBLIGEE any and all costs and expenses which the OBLIGEE may incur by reason of any such default or failure of the PRINCIPAL, then this BOND shall be void; otherwise, this BOND shall be and shall remain in force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes, or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS, and by the CONTRACT, shall not release, in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waiver notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

PROVIDED, FURTHER, this instrument is subject to the provisions of the Act of the General Assembly of the Commonwealth of Pennsylvania approved December 20, 1967, P.L. 869, 8 P.S. Section 191 et seq., known as "Public Works Contractors' Bond Law of 1967".

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Performance Bond – Plumbing Construction 15B

KNOW ALL MEN BY THESE PRESENTS,

That we the undersigned_____

_____
(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____
(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto the Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, in full and just several sums of _____

_____

DOLLARS ($_____)
lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said

OBLIGEE, dated _____, 20____, (hereinafter called the CONTRACT) for

Contract No. 15B – CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part thereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall well, truly and faithfully comply with and perform the CONTRACT in accordance with the CONTRACT DOCUMENTS, at time and in the manner provided in the CONTRACT and in the CONTRACT DOCUMENTS, and if the PRINCIPAL shall satisfy all claims and demands incurred in or related to the performance of the CONTRACT by the PRINCIPAL or growing out of the performance of the CONTRACT by the PRINCIPAL and if the PRINCIPAL shall indemnify completely and shall save harmless the OBLIGEE from any and all costs and damages which the OBLIGEE may sustain or suffer by reason of failure of the PRINCIPAL to do so, and if the PRINCIPAL shall reimburse completely and shall pay to the OBLIGEE any and all costs and expenses which the OBLIGEE may incur by reason of any such default or failure of the PRINCIPAL, then this BOND shall be void; otherwise, this BOND shall be and shall remain in force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes, or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS, and by the CONTRACT, shall not release, in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waiver notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

PROVIDED, FURTHER, this instrument is subject to the provisions of the Act of the General Assembly of the Commonwealth of Pennsylvania approved December 20, 1967, P.L. 869, 8 P.S. Section 191 et seq., known as "Public Works Contractors' Bond Law of 1967".

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Performance Bond – Electrical Construction 16A

KNOW ALL MEN BY THESE PRESENTS,

That we the undersigned_____

_____
(Here insert the name or legal title and address of CONTRACTOR)

as PRINCIPAL, and _____

_____
(Here insert the legal title and address of SURETY)

a corporation organized and existing under the laws of the State of _____ as

SURETY are held and firmly bound unto the Township of Cumru, 1775 Welsh Road, Mohnton, PA 19540

as OBLIGEE, in full and just several sums of _____

_____

DOLLARS ($_____)
lawful money of the United States of America, to be paid to the said OBLIGEE, or its attorney, successors or assigns, to the payment of which sums well and truly to be made, the said PRINCIPAL and SURETY bind themselves, their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents:

WHEREAS, said PRINCIPAL is about to enter into a certain CONTRACT with said

OBLIGEE, dated _____, 20____, (hereinafter called the CONTRACT) for

Contract No. 16A – CUMRU FIRE DEPARTMENT

which CONTRACT and the CONTRACT DOCUMENTS for said WORK shall be deemed a part thereof as fully as if set forth herein.

NOW, THEREFORE, the condition of this BOND shall be such that:

If the PRINCIPAL shall well, truly and faithfully comply with and perform the CONTRACT in accordance with the CONTRACT DOCUMENTS, at time and in the manner provided in the CONTRACT and in the CONTRACT DOCUMENTS, and if the PRINCIPAL shall satisfy all claims and demands incurred in or related to the performance of the CONTRACT by the PRINCIPAL or growing out of the performance of the CONTRACT by the PRINCIPAL and if the PRINCIPAL shall indemnify completely and shall save harmless the OBLIGEE from any and all costs and damages which the OBLIGEE may sustain or suffer by reason of failure of the PRINCIPAL to do so, and if the PRINCIPAL shall reimburse completely and shall pay to the OBLIGEE any and all costs and expenses which the OBLIGEE may incur by reason of any such default or failure of the PRINCIPAL, then this BOND shall be void; otherwise, this BOND shall be and shall remain in force and effect.

The PRINCIPAL and the SURETY agree that any alterations, changes, or additions to the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the WORK to be performed under the CONTRACT in accordance with the CONTRACT DOCUMENTS, and/or any alterations, changes or additions to the CONTRACT, and/or any giving by the OBLIGEE of any extensions of time for the performance of the CONTRACT in accordance with the CONTRACT DOCUMENTS and/or any act of forbearance of either the PRINCIPAL or the OBLIGEE toward the other with respect to the CONTRACT DOCUMENTS and the CONTRACT and/or the reduction of any percentage to be retained by the OBLIGEE as permitted by the CONTRACT DOCUMENTS, and by the CONTRACT, shall not release, in any manner whatsoever, the PRINCIPAL and the SURETY, or either of them, or their heirs, executors, administrators, successors and assigns, from liability under this BOND: and the SURETY, for value received does waiver notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage.

PROVIDED, FURTHER, this instrument is subject to the provisions of the Act of the General Assembly of the Commonwealth of Pennsylvania approved December 20, 1967, P.L. 869, 8 P.S. Section 191 et seq., known as "Public Works Contractors' Bond Law of 1967".

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned.

Witness or Attest: _____
(Principal)

_____ By: _____

Witness: _____
(Surety)

_____ By: _____

Prevailing Wage and Public Works Employment Verification Act

Herein are listed the prevailing minimum wages for the Cumru Fire Department Project. In accordance with the Pennsylvania Prevailing Wage Act of 1961, P.L. 987, No. 442, all contracted public works are required to comply with prevailing minimum wages, including contributions for employee benefits, for the sector in which the work is to be performed.

In accordance with Article 12 of the Regulations for the Pennsylvania Prevailing Wage Act, the Contractor will be required to submit, along with every Application for Progress Payment, certain documentation proving compliance. These documents are included herein and do include:

a. Certified Payroll reports for every week of the pay period indicating the title, labor code, hourly rate, fringe benefits, and various deductions for each employee engaged in the performance of the Contract. NOTE: The L&I-standard certified payroll form may be substituted with alternative documentation provided the necessary data is included.

b. The standard Labor and Industry Statement of Compliance, signed by the Contractor to indicate that all wages are paid in accordance with the area prevailing wage regulations. The first and the last Statement shall be notarized, as indicated on the top of the form.

c. The above document submission requirements shall be also apply to all subcontractor labor performed.

The following is an excerpt from the Regulations for the Pennsylvania Prevailing Wage Act outlining the conditions, provisions and requirements of every public work contract in the state of Pennsylvania. By listing these requirements in the Specifications, they hereby become a part of the Contract:

(1) The general prevailing minimum wage rates including contributions for employee benefits as determined by the Secretary which shall be paid to the workmen employed in the performance of the contract. The contract shall specifically provide that the contractor shall pay at least the wage rates as determined in the decision of the Secretary of Labor and Industry and shall comply with the conditions of the act approved August 15, 1961, and the regulations issued thereto, to assure the full and proper payment of the rates.

(2) The contract shall contain the stipulation that workmen shall be paid at least the general prevailing minimum wage rates and other provisions to assure payment thereof as set forth in this section.

(3) The contract provisions apply to work performed on the contract by the contractor and to work performed on the contract by subcontractors.

(4) The contractor shall insert in each of his subcontracts the stipulations contained in these required provisions and other stipulations as may be required.

(5) The contract shall provide that no workmen may be employed on the public work except in accordance with the classifications in the decision of the Secretary. If additional or different classifications are necessary the procedure in § 9.107 (relating to petition for review of rates and hearings) shall be followed.

(6) The contract shall provide that workmen employed or working on the public work shall be paid unconditionally, regardless of whether a contractual relationship exists or the nature of a contractual relationship which may be alleged to exist between a contractor, subcontractor and workmen, at least once a week, without deduction or rebate, on any account, either directly or indirectly except authorized deductions, the full amounts due at the time of payment, computed at the rates applicable to the time worked in the appropriate classification. Nothing in the contract, the act or this title prohibits the payment of more than the general prevailing minimum wage rates as determined by the Secretary to a workman on public work.

(7) The contract shall provide that the contractor and each subcontractor shall post for the entire period of construction the wage determination decisions of the Secretary, including the effective date of changes thereof, in a prominent and easily accessible place or places at the site of the work and at the places used by them to pay workmen their wages. The posted notice of wage rates shall contain the following information:

(i) The name of project.

(ii) The name of the public body for which it is being constructed.

(iii) The crafts and classifications of workmen listed in the Secretary's general prevailing minimum wage rate determination for the particular project.

(iv) The general prevailing minimum wage rates determined for each craft and classification and the effective date of changes.

(v) A statement advising workmen that if they have been paid less than the general prevailing minimum wage rate for their job classification or that the contractor or subcontractor are not complying with the act or this title, they may file a protest in writing with the Secretary within 3 months of the date of the occurrence, objecting to the payment to a contractor to the extent of the amount due or to become due to them as wages for work performed on the public work project. A workman paid less than the rate specified in the contract shall have a civil right of action for the difference between the wage paid and the wages stipulated in the contract, which right of action shall be exercised within 6 months from the occurrence of the event creating the right.

(8) The contract shall provide that the contractor and subcontractors shall keep an accurate record showing the name, craft or classification, number of hours worked per day and the actual hourly rate of wage paid, including employee benefits, to each workman employed by him in connection with the public work. The record shall include deductions from each workman. The record shall be preserved for 2 years from the date of payment and shall be open at reasonable hours to the inspection of the public body awarding the contract and to the Secretary or his authorized representatives.

(9) The contract shall provide that apprentices shall be limited to numbers in accordance with a bona fide apprenticeship program registered with and approved by The Pennsylvania Apprenticeship and Training Council and only apprentices whose training and employment are in full compliance with The Apprenticeship and Training Act (43 P. S. §§ 90.1–90.10), approved July 14, 1961, and the regulations issued thereto shall be employed on the public work project. A workman using the tools of a craft who does not qualify as an apprentice within this subsection shall be paid the rate predetermined for journeymen in that particular craft or classification.

(10) Wages shall be paid without deductions except authorized deductions. Employers not parties to a contract requiring contributions for employee benefits which the Secretary has determined to be included in the general prevailing minimum wage rate shall pay the monetary equivalent thereof directly to the workmen.

(11) Payment of compensation to workman for work performed on public work on a lump sum basis, or a piece work system, or a price certain for the completion of a certain amount of work, or the production of a certain result shall be deemed a violation of the act and this subchapter, regardless of the average hourly earnings resulting therefrom.

(12) The contract shall also provide that each contractor and each subcontractor shall file a statement each week and a final statement at the conclusion of the work on the contract with the contracting agency, under oath, and in form satisfactory to the Secretary, certifying that workmen have been paid wages in strict conformity with the provisions of the contract as prescribed by this section or if wages remain unpaid to set forth the amount of wages due and owing to each workman respectively.

(13) The provisions of the act and this subchapter shall be incorporated by reference in the contract.

In accordance with The Public Works Employment Verification Act 127, all contractors and subcontractors, as a precondition to receiving a contract on Public Works Projects (defined under the Prevailing Wage Act), are to fully comply with the Act through utilization of the Federal E- Verify Program (EVP) operated by the United States Department of Homeland Security. A fully executed copy of a PUBLIC WORKS EMPLOYMENT VERIFICATION FORM shall be submitted to the Engineer with the contract documents at the time of contract signing. With each pay request, the Contractor shall submit a statement that states that he has fully complied with Act 127 with regard to any new employees.

COMMONWEALTH OF PENNSYLVANIA

PUBLIC WORKS EMPLOYMENT VERIFICATION FORM

Date _____

Business or Organization Name (Employer)_____

Address _____

City _____ State_____ Zip Code _____

☐ Contractor ☐ Subcontractor (check one)

Contracting Public Body _____

Contract/Project No _____

Project Description _____

Project Location _____

As a contractor/subcontractor for the above referenced public works contract, I hereby affirm that as of the above date, our company is in compliance with the Public Works Employment Verification Act ('the Act') through utilization of the federal E-Verify Program (EVP) operated by the United States Department of Homeland Security. To the best of my/our knowledge, all employees hired post January 1, 2013 are authorized to work in the United States.

It is also agreed to that all public works contractors/subcontractors will utilize the federal EVP to verify the employment eligibility of each new hire within five (5) business days of the employee start date throughout the duration of the public works contract. Documentation confirming the use of the federal EVP upon each new hire shall be maintained in the event of an investigation or audit.

I, _____, authorized representative of the company above, attest that the information contained in this verification form is true and correct and understand that the submission of false or misleading information in connection with the above verification shall be subject to sanctions provided by law.

_____

Authorized Representative Signature

Statement of Surety

IN ACCORDANCE with the provisions of the CONTRACT dated _____

between the Township of Cumru
(Owner)

and _____
(Contractor)

the _____
(Surety)

SURETY on the Labor and Material Payment BOND of

_____
(Contractor)

after a careful examination of the books and records of said CONTRACTOR or after receipt of an affidavit from CONTRACTOR, which examination of affidavit satisfies SURETY that all claims, for labor and materials have been satisfactorily settled, hereby approved by the final payment of the said

_____, CONTRACTOR

and by these presents witnessed that payment to the CONTRACTOR of the final estimates shall not relieve surety of any of its obligations to the

Township of Cumru
(Owner)

as set forth in the said SURETY COMPANY'S BOND.

IN WITNESS WHEREOF, said SURETY has hereunto set its hand and seal

this _____ day of _____, 20_____

ATTEST:

_____

(SEAL) _____ BY: _____
(President)

NOTE: This statement, if executed by any person other than the President or Vice President of the Company, must be accompanied by a certificate of even date showing authority conferred upon the person so signing to execute such instruments on behalf of the Company represented.

SECTION 00 6000 - PROJECT FORMS

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

A. Prime Contractors to utilize AIA forms outlined in this section. Contractors shall be required to purchase and provide all AIA documents outlined within this section.

B. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:

C. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732

1. AIA Document A101-2017 "Standard Form of Agreement Between Owner and Contractor, where the basis of payment is a stipulated sum."

    a. The General Conditions of the Project are AIA Document A201-2017 "General Conditions of the Contract for Construction."

2. A draft copy of the General Conditions of the Contract for Construction is included in the Project Manual.
3. The Supplementary General Conditions for Project are separately prepared and included in the Project Manual.
4. AIA Document A305-2020 "Contractor's Qualification Statement."
5. Owner's document(s) bound per Section 00 4400 “Owners Documents.”.
    a. Bid Bond 1A
    b. Bid Bond 15A
    c. Bid Bond 15B
    d. Bid Bond 16A
    e. Bid Form 1A
    f. Bid Form 15A
    g. Bid Form 15B
    h. Bid Form 16A
    i. Bidders Check List
    j. Contractors Affidavit
    k. Contractors Release/Stipulation Against Liens
    l. Owners Documents - Instructions to Bidders
    m. Labor and Material Bond 1A
    n. Labor and Material Bond 15A
    o. Labor and Material Bond 15B
    p. Labor and Material Bond 16A
    q. Maintenance Bond 1A Paving
    r. Maintenance Bond 1A
    s. Maintenance Bond 15A
    t. Maintenance Bond 15B

u. Maintenance Bond 16A
v. Non Collusion Affidavit 1A
w. Non Collusion Affidavit 15A
x. Non Collusion Affidavit 15B
y. Non Collusion Affidavit 16A
z. Performance Bond 1A
aa. Performance Bond 15A
bb. Performance Bond 15B
cc. Performance Bond 16A
dd. Prevailing Wage and Public Works Employment Verification Act
ee. Public Works Employment Verification Form
ff. Statement of Surety
gg. Cumru Township Fire Station, Prevailing Wage Project Rates

1.2 ADMINISTRATIVE FORMS

A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.

B. Prime Contractors to utilize AIA forms outlined in this section to complete the requirements of this section. Contractors shall be required to purchase and provide all AIA documents outlined within this section.

C. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732.

D. Preconstruction Forms:
1. Form of Certificate of Insurance: AIA Document G715-2017 "Supplemental Attachment for ACORD Certificate of Insurance 25."

E. Information and Modification Forms:

1. Form for Requests for Information (RFIs): AIA Document G716-2004 "Request for Information (RFI)."
2. Change Order Form: AIA Document G701-2017 "Change Order."
3. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G710-2017 "Architect's Supplemental Instructions."
4. Form of Change Directive: AIA Document G714-2017 "Construction Change Directive."

F. Payment Forms:

1. Schedule of Values Form: AIA Document G703-1992 "Continuation Sheet."
2. Payment Application: AIA Document G702-1992/703-1992 "Application and Certificate for Payment and Continuation Sheet."
3. Form of Contractor's Affidavit: AIA Document G706-1994 "Contractor's Affidavit of Payment of Debts and Claims."

4. Form of Affidavit of Release of Liens: AIA Document G706A-1994 "Contractor's Affidavit of Payment of Release of Liens."
5. Form of Consent of Surety: AIA Document G707-1994 "Consent of Surety to Final Payment."

END OF SECTION 00 6000

SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Multiple Work Packages.
4. Work under Owner's separate contracts.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Owner-furnished/Owner-installed (OFOI) products.
7. Contractor-furnished/Owner-installed (CFOI) products.
8. Contractor's use of site and premises.
9. Work restrictions.
10. Specification and Drawing conventions.
11. Miscellaneous provisions.

B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 01 7300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

A. Project Identification: Cumru Fire Department.

1. Project Location: 1775 Welsh Road, Mohnton PA 19540.

B. Owner: Cumru Township.

1. Owner's Representative: Jeanne Johnson, 1775 Welsh Road, Mohnton PA 19540.

C. Architect: Manns Woodward Studios Inc..

1. Architect's Representative: Josh Noppenberger, 10839 Philadelphia Rd., White Marsh, MD 21162; 410-344-1460.

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Structural Engineer: Mincin Patel Milano, Inc

a. Structural Engineering Representative: Paul Milano

1) Address: 6511 Harford Road, Baltimore, MD 21214
2) Phone: 410-254-7500

2. Mechanical/Electrical/Plumbing/Fire Suppression Engineer: BKM

a. Mechanical/Electrical Engineering Representative: Tony Page

1) Address: 6300 Blair Hill Lane, Suite 400, Baltimore, Maryland 21209
2) Phone: 410-323-0600

E. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Civil Engineer: One Atlas

a. Civil Engineering Representative: Jeffrey Skinner

1) Address: 920 Germantown Pike, Suite 200, Plymouth Meeting, PA 19462
2) Phone: 267-980-4543

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. The project consists of, generally, the construction of a new single story, with mezzanine, fire station approximately 22,908 gross square feet and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under coordinated, concurrent multiple contracts. See Section 01 1300 – “Contract Package Documents Reference", 01 1320 – “Contract Package Supplementary Instructions and Requirements”, and associated appendices A-E for a list of multiple contracts, a description of work included under each of the multiple contracts, and the responsibilities of Project coordinator.

1.5 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

1. Vehicle Exhaust System (Plymovent): To provide and install a complete vehicle exhaust system.
2. CCTV, Security Cameras, and Access Control Systems.
3. Telephone Systems.
4. Furniture.

1.6 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

    a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. As indicated within drawings.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Each 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.

1. Construction trailers, storage sheds, fabrication sheds, storage of materials and products, and contractor parking shall be prohibited on project site. An off-site staging and storage area shall be provided by the City of Reading for the Contractor's use.

1.8 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 to between 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: Shall only be approved on a case by case basis and only in writing from Owner.
2. Early Morning Hours: Shall only be approved on a case by case basis, shall be approved by the Owner in writing, and shall only occur where authorized by all authorities having jurisdiction.

C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

D. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site is not permitted.

E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.10 MISCELLANEOUS PROVISIONS

A. Each Prime Contractor shall be responsible for ensuring all sub-contractors contracted to perform a portion of the Work have possession of **ALL CONTRACT DOCUMENTS.** Sub-contractors shall be responsible for reviewing all contract documents including but not limited to drawings and specifications and providing all items outlined within the documents to be provided along with all connections, systems, supports, and miscellaneous items required for the items to function properly as intended.

B. Drawing Coordination: Generally, requirements for materials and products identified on Drawings are described in detail in the Specifications. However, items may indicated either only on the drawings or only within the specifications. If items are indicated in one document only it shall be the responsibility of the Contractor to provide the item indicated along with the all components, connections, systems, supports or other miscellaneous items required for the proper operation and installation of the item identified within the single document.

C. References within the Drawings or Specifications to other Drawings or Specifications indicates the potential existence of additional information. If no additional information exists within the referenced drawing(s) or specification(s), the Contractor shall remain responsible for the installation of the Work indicated or graphically depicted. Where Work typically would be structural or load bearing in nature, the Contractor shall provide reinforcement, bracketing, bracing, or otherwise attach such Work as indicated within similar details existing within the Drawings or Specifications. It is also the Contractors responsibility to seek clarification for such items prior to submitting a bid to perform the Work. If no clarification is requested prior to the submission of a bid, it shall be deemed that the Contractor understands the extent of Work both indicated and graphically depicted and has included such within the contract sum.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 1200 - MEASUREMENTS AND PAYMENTS

PART 1 - GENERAL

1.1 BASIS FOR MEASUREMENT AND PAYMENT

A. All measurement for payment will be based on completed work performed in strict accordance with Drawings, Specifications and Construction Details and with the Contract bidding and payment item schedules. All work completed under the Contract shall be measured by the Architect/Engineer according to the methods outlined below. Each pay item describes the necessary and relating work that shall be done under the corresponding Bid Item. If any work and/or material is paid under one item, that same work and/or material will not be paid for under any other item, even though that work and/or material may enter into another item.

B. Requirements for progress payments of the Work completed to date are stated in 01 2900 Payment Procedures.

C. The payment for any item will constitute full compensation for furnishing all labor, materials and equipment required to acceptably complete the item of work.

D. For items where payment limits are shown and/or described, the quantity of material and/or work will be estimated on the basis of length, width and depth as shown or described. In the event that the Contractor feels these fixed limits are not sufficient to fully cover his costs for completing the item, he shall include the extra costs in his bid unit price for the appropriate item. Also, if actual work done and/or material installed is less than the payment limits, then the Contractor shall be paid for actual work and/or material only.

PART 2 - BID ITEMS

2.1 SANITARY SEWER PIPE (Bid Items #1-3)

A. Measurement

1. Measurement will be based on the actual linear feet of sanitary sewer and/or concrete encasement installed between the classifications of depths and pipe diameters as described in the Bid Form from the Pre-Bid surface as shown graphically on the Contract Drawings over the centerline of the trenching to the invert of the pipe. The breaking point between the different classifications of depths will be determined graphically from profiles on the Contract Drawings.

2. Measurement for lengths of the sanitary sewer and/or concrete encasement will be taken along the grade line between the inside edge of manhole walls. The inside diameter of the manholes and the cleanout heights will not be considered as being part of the length of the sewers.

3. Bends, wyes, tees, reducers, and all standard in-line fittings will be included in the measurement of the length on the sanitary sewer installed.

B. Payment

1. Payment will be made at the applicable unit price for the various depths encountered. Pay item includes all related work and materials necessary to complete the gravity sewer as defined in the Specifications and/or shown on the Drawings including, but not limited to the following:

    a. Surveying, staking and marking locations of construction.
    b. Confirming the existing size, location, and elevation of all connecting pipes and structures.
    c. Saw cutting of existing concrete, asphalt or other surface required for trenching.
    d. Any required clearing and grubbing.
    e. Trenching consisting of earth excavation including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
    f. Shoring trench - any types.
    g. Pumping and bailing, including all trench dewatering operations and appurtenances thereto.
    h. Bypass pumping of all sanitary flows as necessary to maintain functioning sewer services around the construction zone.
    i. Removal and disposal of the existing sewer pipes and manholes as noted and/or necessary for system installation. Plug and seal any remaining open ends of remaining abandoned pipe.
    j. Furnishing, laying and joining the pipe, fittings, couplings, cleanouts, and removing existing or furnishing new plugs (if applicable).
    k. Supply and installation of Fernco coupling with stainless steel shear ring or functional equivalent coupling for proper connection to existing sewer mains.
    l. Supply, installation and compaction of pipe bedding, encasement and backfill.
    m. Video testing and repairing leaks.
    n. Backfilling trenches.
    o. Investigate, explore, locate, protect and maintain all utilities above and underground, including but not limited to:

        1) Water mains and service connections including wells
        2) Gas mains and service connections
        3) Electric mains, supports and service connections
        4) Telephone mains, supports and service connections
        5) Storm sewers
        6) All other underground pipelines or structures
        7) All underground traffic light wiring and control lines
        8) Existing sanitary mains, laterals, cleanouts, and vents
        9) Existing sanitary bypass pumping system
        10) Test holes, soft digs or other necessary means for locating underground utilities

p. Provide all safety measures as required by law, i.e. temporary fence, guide rails, etc.
q. Maintenance of traffic during all stages of the construction of the Project, such as pipe construction and repaving.
r. Applying for, obtaining and conforming to any permits required to be procured by the Contractor.
s. Dust Control
t. Supply and installation of trench plugs. (where applicable)
u. Tunneling under curbs and tree roots larger than two (2) inches.
v. Photographs prior to and during construction.
w. All other items which are applicable for the installation of the pipe but not specifically noted in other pay items.

2.2 WATER PIPING (Bid Items #4-5)

A. Measurement

1. Measurement will be based on the actual linear feet of each diameter, type, and depth classification of water mains and services installed as described in the Bid Form.

2. Depth classification will be determined from the Pre-Bid surface elevation as shown graphically on the Contract Drawings over the centerline of the trenching to the invert of the pipe. The breaking point of the depth classifications will be determined graphically from the profiles on the Contract Drawings. If the pipe alignment is changed from the Contract Drawings, a new profile will be obtained before any excavation is done in the area of the alignment change. These new ground elevations will be used to determine the depth classification for payment.

3. Bends, tees, reducers, and all standard in-line fittings will be EXCLUDED from the measurement of the length on the pipe installed.

B. Payment

1. Payment will be made at the applicable unit price for the various diameters, types, and depth classifications of pipes. Pay item includes all related work and materials necessary to complete the water main as defined in the Specifications and/or shown on the Drawings including, but not limited to the following:

a. Protection from contamination of piping while stored on site and awaiting installation.
b. Surveying, staking and marking locations of construction.
c. Saw cutting of existing concrete, asphalt or other surface required for trenching.
d. Any required clearing and grubbing.
e. Trenching consisting of earth excavation including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.

f. Confirming the existing size, location, and elevation of all connecting pipes and structures.
g. Shoring trench - any types.
h. Pumping and bailing, including all trench dewatering operations and appurtenances thereto.
i. Removal of the existing water pipes and appurtenances as noted and/or necessary for system installation. Plug and seal any open ends of remaining abandoned pipe.
j. Furnishing, laying and joining the pipe, gaskets, restrained gaskets, copper fittings, and removing existing or furnishing new plugs (if applicable).
k. Installation and compaction of existing suitable excavated trench material as backfill for non-right-of-way or non-paved areas.
l. Supply, installation and compaction of aggregate pipe bedding, encasement, and backfill.
m. Temporary paving.
n. Pressure testing, disinfection, and any other required testing of installed water systems.
o. Investigate, explore, locate, protect and maintain all utilities above and underground, including but not limited to:

    1) Water mains and service connections including wells
    2) Gas mains and service connections
    3) Electric mains, supports and service connections
    4) Telephone mains, supports and service connections
    5) Storm sewers
    6) All other underground pipelines or structures
    7) All underground traffic light wiring and control lines
    8) Test holes, soft digs or other necessary means for locating underground utilities

p. Provide all safety measures as required by law, i.e. temporary fence, guide rails, etc.
q. Maintenance of traffic during all stages of the construction of the Project, such as pipe construction and repaving.
r. Applying for, obtaining and conforming to any permits required to be procured by the Contractor.
s. Removing surplus excavated materials.
t. Dust Control
u. Supply and installation of trench plugs (if applicable).
v. Tunneling under curbs and tree roots larger than two (2) inches.
w. Photographs prior to and during construction.
x. All other items which are applicable for the installation of the pipe but not specifically noted in other pay items.

2.3 WATER PIPE FITTINGS (Bid Items #6)

A. Measurement

1. Measurement of fittings will be based on the actual pounds of water pipe fittings acceptably installed.

B. Payment

1. Payment for these fittings will be made at the applicable unit price. This price and payment shall constitute compensation in full for furnishing all labor, materials, tools and equipment to acceptably install fittings, including but not limited to the following:

    a. Joining to pipe
    b. Pumping and bailing
    c. Providing and installing corrosion resistant nuts, bolts, gaskets, glands, mechanical retainer glands, restrained joint gaskets, etc.
    d. Testing
    e. Repairing leaks
    f. Removing surplus material
    g. Disinfection
    h. Other incidentals as required to complete the item

2.4 WATER METER PIT (Bid Items #7)

A. Measurement

1. Measurement of the water meters and pits will be for the individual meter pit furnished and installed, complete and in place in accordance with the Specifications and Drawings.

B. Payment

1. Payment for the water meters and pits will be made at the applicable price. Pay item includes all related work necessary to furnish and complete the installation including the following items as shown on Construction Details:

    a. Trenching consisting of earth excavation including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
    b. Supply, installation and compaction of aggregate foundation under pits.
    c. Concrete chamber, lid, and access hatch (where applicable)
    d. All necessary piping, valves, meters, backflow preventers, sensors, fittings and supports within and adjacent to the pit as shown on the Contract Drawings.
    e. Connection to the supply pipes.
    f. Capping or connection to service pipes.
    g. Hatch drainage pipe and stone infiltration systems (where applicable).
    h. Testing
    i. Repairing leaks

j. Removing surplus material
k. Disinfection
l. All other items which are applicable for the installation of the system but not specifically noted in other pay items.

2.5 GAS PIPING (Bid Item #8)

A. Measurement

1. Measurement will be based on the actual linear feet of gas pipe trenching and backfilling as described in the Bid Form.

2. Measurement for lengths of the trench will be taken along the grade line of the pipe.

B. B. Payment

1. Payment will be made at the applicable unit price for the trench. Pay item includes all related work and materials necessary to complete the trenching and backfilling as defined in the Specifications and/or shown on the Drawings including, but not limited to the following:

a. Saw cutting of existing concrete, asphalt or other surface required for trenching.
b. Any required clearing and grubbing.
c. Trenching consisting of earth excavation including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
d. Shoring trench - any types.
e. Pumping and bailing, including all trench dewatering operations and appurtenances thereto.
f. Supply and installation of aggregate pipe bedding and encasement.
g. Furnishing, laying and joining the pipe.
h. Any required valves and fittings.
i. Testing
j. Repairing leaks
k. Installation and compaction of existing suitable excavated trench material as backfill for non-right-of-way or non-paved areas
l. Supply, installation and compaction of aggregate final backfill for right-of-way or paved areas.
m. Installation of appropriate warning tape.
n. Temporary paving.
o. Investigate, explore, locate, protect and maintain all utilities above and underground, including but not limited to:

1) Water mains and service connections including wells
2) Gas mains and service connections
3) Electric mains, supports and service connections
4) Telephone mains, supports and service connections

5) Storm sewers
6) All other underground pipelines or structures
7) All underground traffic light wiring and control lines
8) Existing sanitary bypass pumping system
9) High pressure gas mains
10) Test holes, soft digs or other necessary means for locating underground utilities

p. Provide all safety measures as required by law, i.e. temporary fence, guide rails, etc.
q. Maintenance of traffic during all stages of the construction of the Project, such as pipe construction and repaving.
r. Applying for, obtaining and conforming to any permits required to be procured by the Contractor.
s. Removing surplus excavated materials.
t. Dust Control
u. Supply and installation of trench plugs (if applicable).
v. Tunneling under curbs and tree roots larger than two (2) inches.
w. Photographs prior to and during construction.
x. All other items which are applicable for the installation of the pipe but not specifically noted in other pay items.

2.6 DRAINAGE PIPES (Bid Items #9-18)

A. Measurement

1. Measurement will be based on the actual linear feet of each type and size of drainage pipe and/or concrete cradle installed as described in the Bid Form as shown on the Contract Drawings.

2. Measurement for lengths of the drainage pipe will be taken between the inside edge of structure walls. The inside length and/or width of the structures will not be considered as being part of the length of the drainage pipe.

3. Depth classification will be determined from the Pre-Bid surface elevation as shown graphically on the Contract Drawings over the centerline of the trenching to the invert of the pipe. The breaking point of the depth classifications will be determined graphically from the profiles on the Contract Drawings. If the pipe alignment is changed from the Contract Drawings, a new profile will be obtained before any excavation is done in the area of the alignment change. These new ground elevations will be used to determine the depth classification for payment.

B. Payment

1. Payment will be made at the applicable unit price for each type and size of drainage pipe installed. Pay item includes all related work and materials necessary to complete the drainage pipe as defined in the Specifications and/or shown on the Contract Drawings including, but not limited to the following:

    a. Surveying, staking and marking locations of construction.
    b. Determination of existing storm sewer pipe sizes, locations and elevations.
    c. Saw cutting of existing concrete, asphalt or other surface required for trenching.
    d. Trenching consisting of earth excavation including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
    e. Shoring trench - any types.
    f. Pumping and bailing, including all trench dewatering operations and appurtenances thereto.
    g. Bypass pumping of all drainage flows as necessary around the construction zone.
    h. Removal of the existing sewer pipes, inlets, and manholes as noted and/or necessary for system installation. Plug and seal any remaining open ends of remaining abandoned pipe.
    i. Supply and installation of aggregate pipe bedding.
    j. Furnishing, laying and joining the pipe, fittings, couplings, removing existing or furnishing new plugs (if applicable).
    k. Supply, installation and compaction of aggregate.
    l. Supply, installation and compaction of aggregate final backfill for right-of-way areas.
    m. Temporary paving.
    n. Investigate, explore, locate, protect and maintain all utilities above and underground, including but not limited to:

        1) Water mains and service connections including wells
        2) Gas mains and service connections
        3) Electric mains, supports and service connections
        4) Telephone mains, supports and service connections
        5) Sanitary sewers
        6) All other underground pipelines or structures
        7) All underground traffic light wiring and control lines
        8) Test holes, soft digs or other necessary means for locating underground utilities

    o. Provide all safety measures as required by law, i.e. temporary fence, guide rails, etc.
    p. Maintenance of traffic during all stages of the construction of the Project, such as pipe construction and repaving.
    q. Removing surplus excavated materials.
    r. Dust Control
    s. Tunneling under curbs and tree roots larger than two (2) inches.
    t. Photographs prior to and during construction.

u. All other items which are applicable for the installation of the pipe but not specifically noted in other pay items.

2.7 CAST-IN-PLACE CONCRETE TRENCH DRAIN (Bid Item #19)

A. Measurement

1. Measurement of cast-in-place concrete trench drain will be based on the lineal feet of trench drain constructed or complete in accordance with Contract Drawings and Specifications.

B. Payment

1. Payment for cast-in-place concrete trench drain will be based on the applicable unit price per lineal foot of trench drain. Pay items will include all related work necessary to install the trench drain as shown on the Drawings. Work shall include, but is not limited to the following:

a. Excavation including earth, quicksand, muck, rock or any other materials encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Supply, installation and compaction of aggregate foundation.
c. Forming as required.
d. Supply an installation of epoxy coated reinforcement and dowels.
e. Supply, placement, and finishing of the concrete base and walls
f. Supply and installation of frames and grates
g. Backfilling and compaction of removed driveway aggregate subbase.
h. Removal of surplus materials
i. Temporary paving (where applicable).

2.8 PRECAST CONCRETE STORMWATER AND UTILITY STRUCTURES (Bid Items #20-28)

A. Measurement

1. Measurement of precast concrete stormwater and utility structures will be based on the actual number of structures of the type and size indicated constructed or complete in accordance with Contract Drawings and Specifications.

B. Payment

1. Payment for precast concrete stormwater and utility structures will be based on the applicable unit price per structure. Pay items will include all related work necessary to install the structures as shown on the Drawings. Work shall include, but is not limited to the following:

a. Excavation including earth, quicksand, muck, rock or any other materials encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Supply, installation and compaction of aggregate foundation.
c. Furnishing and installation of precast concrete structure.
d. Tops, frames, grates, hatches, and covers
e. Steps
f. Water quality hoods, devises, and equipment.
g. Trash racks
h. Sealing of wall joints
i. Backfilling with same materials as specified for pipes
j. Removal of surplus materials
k. Temporary paving (where applicable).

2.9 HDPE STORMWATER STRUCTURES (Bid Items #29-30)

A. Measurement

1. Measurement of HDPE stormwater structures will be based on the actual number of structures of the type and size indicated installed in accordance with plans and specifications.

B. Payment

1. Payment for HDPE stormwater structures will be based on the applicable unit price per structure. Pay items will include all related work necessary to install the structures as shown on the Drawings. Work shall include, but is not limited to the following:

a. Excavation including earth, quicksand, muck, rock or any other materials encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Supply, installation and compaction of aggregate foundation.
c. Furnishing and installation of HDPE structure.
d. Backfilling with same materials as specified for pipes

2.10 CONSTRUCTION OF BASIN 5 (Bid Item #31)

A. Measurement

1. Measurement be a lump sum for grading and construction of the infiltration basin area as required in accordance with the Drawings.

B. Payment

1. Payment will be based at the applicable lump price for the grading of the infiltration basin area as shown on drawings. Pay items will include all related work necessary construct the infiltration basin including but not limited to the following:

a. Grading surface to appropriate elevation, including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Removal and disposal of pavement, debris and other unacceptable material.
c. Soil preparation
d. Supply and installation of amended soils
e. Reinstallation of topsoil
f. Removal of surplus materials
g. Seeding with appropriate vegetation

2.11 CONSTRUCTION OF BASIN 6 (Bid Item #32)

A. Measurement

1. Measurement will be made on the actual square yards of underground infiltration basin constructed as required in accordance with the Drawings.

B. Payment

1. Payment will be based at the applicable lump price for the construction of the underground infiltration basin area as shown on drawings. Pay items will include all related work necessary construct the underground infiltration basin including but not limited to the following:

a. Grading surface to appropriate elevation, including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Removal and disposal of pavement, debris and other unacceptable material.
c. Supply and installation of geotextile fabric.
d. Supply and installation of appropriate aggregate.
e. Supply and install of underdrain piping.
f. Supply and install of infiltration chambers (StormTech or equal) and cleanouts.
g. Removal of surplus materials

2.12 CONSTRUCTION OF SWALES (Bid Item #33-34)

A. Measurement

1. Measurement be a lump sum for grading of swale areas as required in accordance with the Drawings.

B. Payment

1. Payment will be based at the applicable lump price for the grading of the swale areas as shown on drawings. Pay items will include all related work necessary construct the infiltration basin including but not limited to the following:

a. Grading surface to appropriate elevation, including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Removal and disposal of pavement, debris and other unacceptable material.
c. Soil preparation.
d. Supply and installation of amended soils (if required).
e. Reinstallation of topsoil.
f. Removal of surplus materials.
g. Seeding with appropriate vegetation.

2.13 RIPRAP (Bid Items #35-36)

A. Measurement

1. Measurement of Riprap will be based on the actual number of cubic yards of the type and size indicated installed in accordance with plans and specifications.

B. Payment

1. Payment for Riprap will be based on the applicable unit price. Pay items will include all related work necessary to install the riprap as shown on the Contract Drawings. Work shall include, but is not limited to the following:

a. Excavation including earth, quicksand, muck, rock or any other materials encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Preparation and compaction of subbase.
c. Supply and installation geotextile fabric.
d. Supply and installation of riprap stone.
e. Rough grading along edges of installed riprap.

2.14 PAVEMENT SUBGRADE PREPARATION (Bid Item #37)

A. Measurement

1. Measurement will be based on the actual number of square yards of pavement subgrade preparation to the over the surface indicated to the limits on the plan.

B. Payment

1. Payment will be made based on the applicable unit price for the square yards of subgrade preparation. Pay items will include all related work necessary to complete the repaving including, but not limited to, the following:

a. Grading surface to appropriate elevation, including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.

b. Removal and disposal of pavement, debris and other unacceptable material.
c. Compacting and proof rolling surface.
d. Removal of surplus materials.
e. Maintenance of traffic.

2.15 AGGREGATE SUBBASE PLACEMENT (Bid Item #38)

A. Measurement

1. Measurement will be based on the actual number of square yards of aggregate subbase installed to the depth and limits indicated on the Contract Drawings.

B. Payment

1. Payment will be made based on the applicable unit price for the square yards of indicated thickness aggregate subbase being installed. Pay items will include all related work necessary to complete the repaving including, but not limited to, the following:

a. Furnishing and placing aggregate subbase material to the indicated thickness.
b. Compacting aggregate subbase material to the indicated thickness.
c. Removal of surplus materials.
d. Maintenance of traffic.

2.16 ASPHALT PAVEMENT COURSES (Bid Items #39-40)

A. Measurement

1. Measurement will be based on the actual type, depth and number of square yards of asphalt pavement installed over the surface indicated to the limits on the plan. Any pavement damaged by the contractor outside these limits will be repaired or replaced at their expense.

B. Payment

1. Payment will be made based on the applicable unit price for the square yards and thickness of pavement that is being installed. Pay items will include all related work necessary to complete the repaving including, but not limited to, the following:

a. Surface sweeping and preparation (if applicable).
b. Furnishing and placing paving material.
c. Compacting paving.
d. Sealing final surface edge of pavement adjacent to existing paving, curbing, concrete structures, and utility structures.
e. Removal of surplus materials.
f. Maintenance of traffic.
g. Pavement markings and painting.
h. Maintaining paving for the duration of the two (2) year Maintenance Bond

2.17 CONCRETE DRIVEWAY SUBBASE PREPARATION (Bid Item #41)

A. Measurement

1. Measurement will be based on the actual number of square yards of pavement subbase preparation to the limits on the plan.

B. Payment

1. Payment will be made based on the applicable unit price for the square yards of subbase preparation. Pay items will include all related work necessary to prepare the area for the concrete driveway construction including, but not limited to, the following:

    a. Regrading of the existing aggregate subbase material to the elevation required.
    b. Removal and disposal of pavement, debris and other unacceptable material
    c. Supply and installation of additional aggregate subbase (if required).
    d. Compacting and proof rolling surface.
    e. Removal of surplus materials.

2.18 CONCRETE DRIVEWAY PAVEMENT (Bid Items #42)

A. Measurement

1. Measurement will be based on the actual type, depth and number of square yards of concrete pavement installed over the surface indicated to the limits on the plan. Any pavement damaged by the contractor outside these limits will be repaired or replaced at their expense.

B. Payment

1. Payment will be made based on the applicable unit price for the square yards and thickness of pavement that is being installed. Pay items will include all related work necessary to complete the repaving including, but not limited to, the following:

    a. Forming.
    b. Supply and installation of epoxy coated reinforcement.
    c. Supply, placement, and finishing of concrete.
    d. Supply and installation of expansion and control joints.
    e. Surface sealing.
    f. Removal of surplus materials.
    g. Maintenance of traffic.
    h. Maintaining paving for the duration of the two (2) year Maintenance Bond

2.19 CONCRETE CURBING (Bid Item #43)

A. Measurement

1. Measurement will be made on a linear foot basis for the actual length of curb installed and/or replaced where required in accordance with the Drawings.

B. Payment

1. Payment will be based at the applicable unit price for the curb installation and/or restoration within the construction limits as shown on drawings. Pay items will include all related work necessary to complete the curb replacement including but not limited to the following:

    a. Earth excavation including rock, quicksand, and any other type of material encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
    b. Subbase preparation
    c. Formwork
    d. Concrete
    e. Reinforcement (if required)
    f. Finishing
    g. Removing surplus materials

2.20 REINFORCED CONCRETE PARKING LOT RETAINING WALL (Bid Item #44)

A. Measurement

1. Measurement of the reinforced concrete retaining wall will be lump sum for the wall constructed, complete and in place in accordance with the Specifications and Drawings.

B. Payment

1. Payment for the reinforced concrete retaining wall will be made at the applicable lump sum price. Pay item includes all related work necessary to furnish and complete the installation including the following items as shown on Construction Details:

    a. Trenching consisting of earth excavation including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
    b. Subgrade preparation.
    c. Supply and installation of aggregate subbase.
    d. All required formwork and supports.
    e. Reinforcing steel, ties chairs, and supports.
    f. Concrete supplied, installed, and wired.
    g. Supply and installation of the solid grouted CMU shelf
    h. Supply and installation of stone veneer as selected by owner
    i. Finishing

j. Underdrain system, piping, and stone supplied and installed.
k. Backfill and grading.
l. All other items which are applicable for the installation of the retaining wall but not specifically noted in other pay items.

2.21 FIRESTATION PATIO AND RETAINING WALL (Bid Item #45)

A. Measurement

1. Measurement of the reinforced concrete retaining wall will be lump sum for the patio and retaining wall constructed, complete and in place in accordance with the Specifications and Drawings.

B. Payment

1. Payment for the reinforced concrete retaining wall and patio will be made at the applicable lump sum price. Pay item includes all related work necessary to furnish and complete the installation including the following items as shown on Construction Details:

a. Trenching consisting of earth excavation including rock excavation, quicksand, and any other type of excavation encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Subgrade preparation.
c. Supply and installation of aggregate subbase.
d. All required formwork and supports.
e. Reinforcing steel, ties chairs, and supports.
f. Concrete supplied, installed, and wired.
g. Supply and installation of expansion and control joints.
h. Supply and installation of the solid grouted CMU shelf
i. Supply and installation of stone veneer as selected by owner
j. Finishing
k. Underdrain system, piping, and stone supplied and installed.
l. Backfill and grading.
m. All other items which are applicable for the installation of the retaining wall but not specifically noted in other pay items.

2.22 CONCRETE STAIRS AND RAILING (Bid Item #46)

A. Measurement

1. Measurement will be made on a lump sum basis for the full length of concrete stairs and handrail installed where required in accordance with the Drawings.

B. Payment

1. Payment will be based at the applicable unit price for the curb installation and/or restoration within the construction limits as shown on drawings. Pay items will include all related work necessary to complete the stairway and railing install including but not limited to the following:

    a. Earth excavation including rock, quicksand, and any other type of material encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
    b. Subbase preparation
    c. Formwork
    d. Supply and installation of epoxy coated reinforcement.
    e. Supply and installation of concrete.
    f. Finishing
    g. Supply and installation of handrail system.
    h. Removing surplus materials.

2.23 CONCRETE SIDEWALK (Bid Item #47)

A. Measurement

1. Measurement will be made on a square yard basis for the actual area of concrete sidewalk installed to the depth and limits as shown on the Drawings.

B. Payment

1. Payment will be based at the applicable unit price for the sidewalk installation within the construction limits as shown on drawings. Pay items will include all related work necessary to complete the sidewalk placement including but not limited to the following:

    a. Earth excavation including rock, quicksand, and any other type of material encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
    b. Subbase preparation
    c. Supply and installation of aggregate subbase
    d. Formwork
    e. Supply and installation of concrete and reinforcement (if required)
    f. Supply and installation of expansion and control joints.
    g. Finishing
    h. Removing surplus materials.

2.24 STONE VENEER (Bid Item #48)

A. Measurement

1. Measurement will be made on a lump sum basis for the stone veneer installed on the existing retaining wall in accordance with the Drawings.

B. Payment

1. Payment will be based at the lump sum price for the stone veneer installed on the existing retaining wall as shown on drawings. Pay items will include all related work necessary to complete the stone veneer placement including but not limited to the following:

   a. Earth excavation including rock, quicksand, and any other type of material encountered. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
   b. Supply and installation of the solid grouted CMU shelf
   c. Supply and installation of stone veneer as selected by owner
   d. Finishing
   e. Restoration of grading and landscaping.
   f. Removing surplus materials

2.25 SIGNAGE (Bid Item #49)

A. Measurement

1. Measurement will be made on a lump sum basis for the signage installed on the existing retaining wall in accordance with the Drawings.

B. Payment

1. Payment will be based at the lump sum price for the signage installed on the existing retaining wall as shown on drawings. Pay items will include all related work necessary to complete the signage placement including but not limited to the following:

   a. Supply and installation of sign anchors into the stone veneer and/or reinforced concrete.
   b. Supply and installation of sign as selected by owner.
   c. Removing surplus materials.

2.26 FENCING (Bid Item #50)

A. Measurement

1. Measurement will be made on a linear foot basis for the actual length of fencing installed in accordance with the Drawings.

B. Payment

1. Payment will be based at the applicable unit price for the fence installation as shown on drawings. Pay items will include all related work necessary to complete the fence placement including but not limited to the following:

a. Earth excavation including rock, quicksand, and any other type of material encountered for posts and foundation. Excavated material to be delivered and deposited at locations determined by the type and quality of material.
b. Supply and installation of concrete foundations.
c. Supply and installation of the fencing
d. Supply and installation of the gates and hardware.
e. Removing surplus materials.

2.27 SITE GRADING (Bid Items #51)

A. Measurement

1. Measurement will be a lump sum for grading of the site within the project limits to the required contours.

B. Payment

1. Payment for this work will be made in accordance with the applicable lump sum price for the site including, but not limited to, the following:

a. Removal and disposal of any construction debris and unnatural materials.
b. Grading to the required elevations.
c. Dust control
d. Relocation of soil within the site as necessary.
e. Compaction of soil.
f. Preparation of surface for topsoil replacement.

2.28 LANDSCAPING (Bid Items #52)

A. Measurement

1. Measurement will be made on a lump sum basis for the landscaping and ground cover installed where shown in accordance with the Drawings.

B. Payment

1. Payment will be based at the applicable lump sum price for the landscaping and ground cover installed as shown on drawings. Pay items will include all related work necessary to install landscaping and ground cover including but not limited to the following:

a. Excavation.
b. Soil preparation
c. Supply and installation of plantings.
d. Backfilling with appropriate soil.
e. Mulching and surface stabilization.
f. Staking, guying, and planting protection.
g. Supplying and placement of river rock where applicable.

h. Fertilizing and watering as needed for one year from project completion.
i. Removal of surplus materials

2.29 EROSION CONTROL (Bid Items #53)

A. Measurement

1. Measurement will be based on a lump sum for the installation, maintenance, repair, replacement, and removal of Erosion and Sedimentation Control system as required by the Berks County Conservation District and per the approved NPDES permit.

B. Payment

1. Payment for the successfully completed work will be made at the lump sum price in the bid form to be paid as a percentage of contract completion. This price constitutes full compensation for all labor, materials and equipment necessary to successfully complete the work to the satisfaction of local SCS, Owner, Engineer, or any other regulatory agency having jurisdiction in this matter, including, but not limited to, the following:

a. Silt soxx, installation, maintenance, and removal
b. Super silt fence installation and maintenance
c. Rock filter installation and maintenance
d. Construction entrance installation and maintenance
e. Street and pavement sweeping and vacuuming
f. Topsoil stockpiling and respreading
g. Sediment trap outlet structures and pipes
h. Sediment basin baffles
i. Erosion control matting installation
j. Inlet protection, installation, maintenance, and removal
k. Sedimentation removal
l. Temporary seeding and stabilization
m. Fine grading and power raking
n. Permanent stabilization seeding

END OF SECTION 01 1200

SECTION 01 1300 – CONTRACT PACKAGE DOCUMENT REFERENCE

PART 1 – GENERAL

1.1 SUMMARY

A. This section outlines the separate Contract Packages required to complete the Scope of Work of the CUMRU FIRE DEPARTMENT. Each Contract Package indicated within this Section shall include both specific Specification Sections and specific drawing groups and drawings. The Contractor awarded each Contract Package respectively shall be responsible to perform all Work required by the indicated/referenced Specification Sections and Drawings listed under each Contract Package within this Section. Additionally, each Contractor shall be responsible for Work referenced within PART 1 of each Specification Section listed within their respective Contract Packages.

B. Related Documents and Specification Sections

1. All Contractors shall be responsible for the information within and shall comply with requirements of Division 00 – Bidding Requirements and Division 01 – General Requirements along with all other procurement documents stipulated by the Invitation to Bid.
2. All Prime Contractors are responsible for reviewing and understanding all drawings and specifications whether included within their Contract Package or another Contract Package. Each document contains critical information for the coordination and completion of the Work of the Project.
3. Section 01 1320 "CONTRACT PACKAGE SUPPLEMENTARY INSTRUCTIONS AND REQUIREMENTS"
4. All Contractors shall comply with requirements of the listed "G" Series Drawings – General/Code.
    1. G000 Cover Sheet
    2. G001 Code Analysis
    3. G002 Code Plans & Diagrams
    4. G003 Typical Accessibility Guidelines

1.2 CONTRACT PACKAGES

A. **1A – GENERAL CONTRACT PACKAGE**

1. Specification Sections
    a. **DIVISION 3 – CONCRETE**
        1. Cast-In-Place Concrete
    b. **DIVISION 4 – MASONRY**
        1. Unit Masonry
    c. **DIVISION 5 – METALS**
        1. Structural Steel
        2. Steel Joists
        3. Steel Deck
        4. Cold Formed Metal Framing
        5. Metal Fabrications
        6. Metal Grating Stairs

7. Pipe and Tube Railings
8. Decorative Metal Railings

d. **DIVISION 6 – WOOD PLASTICS AND COMPOSITES**
1. Miscellaneous Rough Carpentry
2. Sheathing
3. Interior Finish Carpentry
4. Plastic-Laminate Faced Architectural Cabinets
5. Plastic Paneling

e. **DIVISION 7 – THERMAL AND MOISTURE PROTECTION**
1. Bituminous Dampproofing
2. Thermal Insulation
3. Vapor Retarders
4. Fluid Applied Membrane Air Barrier
5. Standing Seam Metal Roof Panels
6. Formed Metal Wall Panels
7. Insulated Metal Wall Panels
8. Soffit Panels
9. Sheet Metal Flashing and Trim
10. Roof Accessories
11. Snow Guards
12. Penetration Firestopping
13. Preformed Joint Seals
14. Joint Sealants
15. Interior Expansion Joint Cover Assemblies

f. **DIVISION 8 – OPENINGS**
1. Hollow Metal Doors and Frames
2. Flush Wood Doors
3. Access Doors and Frames
4. Aluminum-Framed Entrances and Storefronts
5. Glazed Aluminum Curtain Walls
6. Four-Fold Door Systems
7. Pass-Through Windows
8. Door Hardware
9. Door Hardware Schedule
10. Glazing
11. Mirrors
12. Fire-Resistant Glazing
13. Fixed Louvers

g. **DIVISION 9 – FINISHES**
1. Moisture Vapor Emission Control
2. Non-structural Metal Framing
3. Gypsum Board
4. Ceramic Tiling
5. Acoustical Panel Ceilings
6. Acoustical Metal Panel Ceilings
7. Linear Metal Ceilings

8. Resilient Base and Accessories
9. Resilient Tile Flooring
10. Static-Control Resilient Flooring
11. Resilient Athletic Flooring
12. Resinous Flooring
13. Tile Carpeting
14. Metal Interior Wall Panels
15. Sound Absorbing Wall Units
16. Exterior Painting
17. Interior Painting
18. High-Performance Coatings

h. **DIVISION 10 – SPECIALTIES**
1. Dimensional Letter Signage
2. Panel Signage
3. Building Mounted Signage
4. Plastic Toilet Compartments
5. Wall and Door Protection
6. Toilet, Bath and Laundry Accessories
7. Fire Extinguisher Cabinets
8. Fire Extinguishers
9. Welded Metal Lockers

i. **DIVISION 12 – FURNISHINGS**
1. Roller Window Shades
2. Solid Surfacing Countertops
3. Quartz Agglomerate Countertops

j. **DIVISION 22 – PLUMBING**
1. Storm Water Piping

k. **DIVISION 31 – EARTHWORK**
1. Excavation and Earthwork
2. Earthwork for utilities
3. Erosion and Sediment Control
4. Landscaping Grading
5. Seeding
6. Trees Plants and Ground Cover
7. Dewatering

l. **DIVISION 32 – EXTERIOR IMPROVEMENTS**
1. Paving and Resurfacing
2. Miscellaneous Concrete

m. **DIVISION 33 – UTILITIES**
1. Sanitary Sewers and Appurtenances
2. Water Mains and Appurtenances
3. Precast Utility Structures
4. Testing and Disinfecting Water Mains
5. Storm Sewer Pipe

2. **DRAWING GROUPS AND DRAWINGS**
   a. **Civil Drawings:**
      1. 100 Title Sheet
      2. 147 Existing Features Plan
      3. 148 Construction Plan
      4. 148.1 Site Details & Profile
      5. 148.2 Grading Plan
      6. 148.3 Grading Details & Profiles
      7. 148.4 Wall Details
      8. 148.5 Drainage & Utility Plan
      9. 148.6 Landscaping Plan & Details
      10. 166 Erosion & Sedimentation Control Plan
      11. 166.1 Erosion & Sedimentation Control Notes
      12. 166.2 Erosion & Sedimentation Control Notes
      13. 166.3 Erosion & Sedimentation Control Details
      14. 166.4 Erosion & Sedimentation Control Details
      15. 183 Post Construction Stormwater Management Grading Plan
      16. 183.1 Post Construction Stormwater Management Utility Plan
      17. 183.2 Post Construction Stormwater Management Notes
      18. 183.3 Post Construction Stormwater Management Details
      19. 183.4 Post Construction Stormwater Management Basin #5 Details
      20. 183.5 Post Construction Stormwater Management Basin #6 Details
      21. 183.6 Post Construction Stormwater Management Basin #6 Details
      22. 183.7 Post Construction Stormwater Management Profiles
      23. 183.8 Post Construction Stormwater Management Profiles
      24. 184 Pre-Development Phase #2 Drainages
      25. 184.1 Post Development Phase #2 Drainages
   b. **Architectural Drawings: "A" Series**
      1. A100 Architectural Site Diagram
      2. A100.1 Exterior Site Slab Diagram
      3. A101 Reference Plan
      4. A102 Dimension Plan
      5. A103 Construction Types
      6. A104 Slab/Masonry Diagram
      7. A105 Finish Plan
      8. A106 Finish Schedule & Details
      9. A107 Finish Details
      10. A108 Equipment & Blocking Plan
      11. A109 Clerestory Plan
      12. A110 Plan Details
      13. A111 Entry Plan, Elevations & Details

14. A112 Exterior Stair Details
15. A113 Site Details
16. A114 Signage Details
17. A200 Building Elevations
18. A300 Transverse Building Sections
19. A301 Longitudinal Building Sections
20. A400 Wall Sections
21. A401 Wall Sections
22. A402 Wall Sections
23. A403 Wall Sections
24. A404 Wall Sections
25. A405 Typical Foundation Details
26. A406 Typical Stair Details
27. A407 Typical Guardrail Details
28. A500 Roof Plan
29. A501 Roof Details
30. A502 Roof Details
31. A503 Roof Details
32. A504 Roof Penetration & Lightning Protection Details
33. A600 Door/Window Schedule & Types
34. A601 Exterior & Interior Door Details
35. A602 Exterior & Interior Window Details
36. A603 Exterior Storefront Elevations & Details
37. A604 Exterior Storefront Elevations & Details
38. A700 Typical Equipment & Casework Details
39. A701 Enlarged Plans & Int. Elevations
40. A702 Enlarged Plans & Int. Elevations
41. A703 Enlarged Plans & Int. Elevations
42. A704 Enlarged Plans & Int. Elevations
43. A705 Enlarged Plans & Int. Elevations
44. A706 Enlarged Plans & Int. Elevations
45. A707 Enlarged Plans & Int. Elevations
46. A708 Enlarged Plans & Int. Elevations
47. A709 Enlarged Plans & Int. Elevations
48. A800 Reflected Ceiling Plans
49. A801 Enlarged Ceiling Plans & Details
50. A900 Misc Details

c. **Structural Drawings: "S" Series**

1. S101 Foundation/First Floor Plan
2. S102 Mezzanine Framing Plan
3. S103 Roof Framing Plan
4. S104 High Roof
5. S201 General Notes & Schedules
6. S301 Typical Details
7. S302 Typical Details
8. S303 Typical Details

9. S401 Sections
10. S402 Sections
11. S403 Sections
12. S404 Sections
13. S405 Sections

d. **Plumbing Drawings: "P" Series**
1. P100 Foundation Plan - Plumbing

B. **15A – MECHANICAL CONTRACT PACKAGE**

1. Specification Sections

a. **DIVISION 3: CONCRETE**
1. Cast-In-Place Concrete

b. **DIVISION 4: MASONRY**
1. Concrete Unit Masonry – Coordination Only

c. **DIVISION 5: METALS**
1. Metal Fabrications

d. **DIVISION 6: WOODS PLASTICS AND COMPOSITES**
1. Miscellaneous Rough Carpentry

e. **DIVISION 7: THERMAL AND MOISTURE PROTECTION**
1. Roof Accessories
2. Penetration Firestopping
3. Joint Sealants

f. **DIVISION 8: OPENINGS**
1. Access Doors and Frames
2. Fixed Louvers

g. **DIVISION 23: HEATING VENTILATING AND AIR CONDITIONING**
1. Basic HVAC Requirements
2. Project Closeout HVAC
3. Basic HVAC Materials and Methods
4. Electrical Provisions for HVAC Equip
5. Meters and Gauges for HVAC Piping
6. Valves for HVAC Piping
7. Hangers and Supports for HVAC Piping and Equip
8. Vibration Isolation for HVAC Piping and Equip
9. Seismic and Wind Controls for HVAC Piping and Equipment
10. Identification for HVAC Piping and Equip
11. Testing, Adjusting, and Balancing
12. HVAC Insulation
13. Commissioning of HVAC Systems
14. Automatic Control Systems (Electric-Electronic)
15. Hydronic Piping
16. Hydronic Specialties
17. HVAC Pumps
18. Refrigerant Piping
19. Water Treatment

20. Low Pressure Ductwork
21. Ductwork Accessories
22. Fans
23. Air Outlets and Inlets
24. Breeching and Stacks
25. Condensing Boilers
26. Indoor Air Handling Units
27. Environmental Control Air Conditioning Units
28. Variable Refrigerant Volume Systems
29. Heating and Cooling Terminal Units
30. Radiant Floor Heating Systems

h. **DIVISION 31 – EARTHWORK**
1. Excavation and Earthwork
2. Earthwork for utilities
3. Dewatering

i. **DIVISION 32 – EXTERIOR IMPROVEMENTS**
1. Miscellaneous Concrete

j. **DRAWING GROUPS AND DRAWINGS**

k. **Civil Drawings:**

a. 100 Title Sheet
b. 148 Construction Plan
c. 148.1 Site Details & Profile
d. 148.2 Grading Plan
e. 148.3 Grading Details & Profiles
f. 148.4 Wall Details
g. 148.5 Drainage & Utility Plan

2. **Architectural: "A" Series**

a. A100 Architectural Site Diagram
b. A100.1 Exterior Site Slab Diagram
c. A103 Construction Types
d. A104 Slab/Masonry Diagram
e. A108 Equipment & Blocking Plan
f. A113 Site Details
g. A200 Building Elevations
h. A500 Roof Plan
i. A504 Roof Penetration & Lightning Protection Details
j. A600 Door/Window Schedule & Types
k. A704 Enlarged Plans & Int. Elevations
l. A708 Enlarged Plans & Int. Elevations
m. A709 Enlarged Plans & Int. Elevations
n. A800 Reflected Ceiling Plan
o. A801 Enlarged Ceiling Plans & Details

3. **Mechanical: "M" Series**

a. M001 Mechanical Legend Abbreviations and General Notes

b. M101 First Floor Plan Ductwork
c. M201 First Floor Plan HVAC Piping
d. M301 Part Floor Plans HVAC
e. M401 Mechanical Sections
f. M402 Mechanical Sections
g. M501 Mechanical Details
h. M502 Mechanical Details
i. M601 Mechanical Controls
j. M701 Mechanical Schedules
k. M702 Mechanical Schedules

4. **Plumbing: "P" Series**
   a. P001 Plumbing Legend, Abbrev. Schedules & General Notes

C. **15B – PLUMBING CONTRACT PACKAGE**

1. Specification Sections
   a. **DIVISION 3: CONCRETE**
      1. Cast-In-Place Concrete
   b. **DIVISION 4: MASONRY**
      1. Concrete Unit Masonry
   c. **DIVISION 5: METALS**
      1. Metal Fabrications
   d. **DIVISION 6: WOODS PLASTICS AND COMPOSITES**
      1. Rough Carpentry
   e. **DIVISION 7: THERMAL AND MOISTURE PROTECTION**
      1. Penetration Firestopping
      2. Joint Sealants
   f. **DIVISION 8: OPENINGS**
      1. Access Doors and Frames
   g. **DIVISION 21: FIRE SUPPRESSION**
      1. Fire Protection
   h. **DIVISION 22: PLUMBING**
      1. Basic Plumbing Requirements
      2. Project Closeout Plumbing
      3. Basic Plumbing Materials and Methods
      4. Plumbing Related Work
      5. Electrical Provisions for Plumbing Equip
      6. Pipe, Tube, and Fittings for Plumbing Systems
      7. Piping Specialties for Plumbing Systems
      8. Meters and Gauges for Plumbing Piping
      9. Valves for Plumbing Piping
      10. Hangers and Supports for Plumbing Piping and Equip
      11. Seismic and Wind Controls
      12. Identification for Plumbing Piping and Equip
      13. Plumbing Insulation
      14. Domestic Water Piping

15. Plumbing Pumps
16. Soil, Waste, and Vent Piping
17. Storm Water Piping
18. Plumbing Equipment
19. Plumbing Fixtures
20. Natural Gas Systems

i. **DIVISION 31 - EARTHWORK**
1. Excavation and Earthwork
2. Earthwork for utilities
3. Dewatering

j. **DIVISION 32 – EXTERIOR IMPROVEMENTS**
1. Miscellaneous Concrete

2. **DRAWING GROUPS AND DRAWINGS**

1. **Civil Drawings Series**

a.	100	Title Sheet
b.	147	Existing Features Plan
c.	148	Construction Plan
d.	148.1	Site Details & Profile
e.	148.2	Grading Plan
f.	148.3	Grading Details & Profiles
g.	148.5	Drainage & Utility Plan
h.	148.6	Landscaping Plan & Details

2. **Architectural: "A" Series**

a.	A100	Architectural Site Diagram
b.	A100.1	Exterior Site Slab Diagram
c.	A103	Construction Types
d.	A104	Slab/Masonry Diagram
e.	A107	Finish Details
f.	A108	Equipment & Blocking Plan
g.	A113	Site Details
h.	A200	Building Elevations
i.	A500	Roof Plan
j.	A504	Roof Penetration & Lightning Protection Details
k.	A700	Enlarged Plans & Int. Elevations
l.	A701	Enlarged Plans & Int. Elevations
m.	A702	Enlarged Plans & Int. Elevations
n.	A703	Enlarged Plans & Int. Elevations
o.	A704	Enlarged Plans & Int. Elevations
p.	A705	Enlarged Plans & Int. Elevations
q.	A900	Misc Details

3. **Plumbing: "P" Series**

a.	P001	Plumbing Legend, Abbrev, Schedules & General Notes
b.	P002	Site Plan Plumbing New Work
c.	P100	Foundation Plan Plumbing

d.	P101	First Floor Plan – Plumbing
e.	P201	Part Floor Plans Plumbing
f.	P301	Plumbing Details
g.	P302	Plumbing Details
h.	P303	Plumbing Details
i.	P401	Plumbing Riser Diagrams
j.	P402	Plumbing Riser Diagrams
k.	P403	Plumbing Riser Diagrams

D. **16A – ELECTRICAL CONTRACT PACKAGE**

1. Specification Sections
   a. **DIVISION 3: CONCRETE**
      1. Cast-In-Place Concrete
   b. **DIVISION 4: MASONRY**
      1. Concrete Unit Masonry – Coordination Only
   c. **DIVISION 5: METALS**
      1. Metal Fabrications
   d. **DIVISION 6: WOODS PLASTICS AND COMPOSITES**
      1. Rough Carpentry
   e. **DIVISION 7: THERMAL AND MOISTURE PROTECTION**
      1. Penetration Firestopping
      2. Joint Sealants
   f. **DIVISION 8: OPENINGS**
      1. Access Doors and Frames
      2. Four-Fold Door Systems
   g. **DIVISION 26: ELECTRICAL**
      1. Basic Electrical Materials and Methods
      2. Project Closeout Electrical
      3. Inspections, Testing and Start-up
      4. Wires and Cables
      5. Grounding
      6. Supporting Devices
      7. Raceways
      8. Boxes, Fittings and Cabinets
      9. Underground Electrical Structures
      10. Seismic and Wind Controls
      11. Coordination Study
      12. Lighting Control Systems
      13. Transformers
      14. Panelboards
      15. Wiring Devices
      16. Electrical Connections
      17. Disconnects, Switches and Contactors
      18. Enclosed Circuit Breakers
      19. Motor Controllers
      20. Diesel Generator System

21. Automatic Transfer Switches
22. Lightning Protection
23. Integrated SPD
24. Lighting Fixtures (LED)
25. Telephone and Data Systems Support

h. **DIVISION 27 – COMMUNICATIONS**
1. Common Work Results For Communications
2. Communication Backbone Cabling
3. Communication Horizontal Cabling

i. **DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**
1. Fire Detection and Alarm System

j. **DIVISION 31 - EARTHWORK**
1. Excavation and Earthwork
2. Earthwork for utilities
3. Dewatering

k. **DIVISION 32 – EXTERIOR IMPROVEMENTS**
1. Miscellaneous Concrete

2. **DRAWING GROUPS AND DRAWINGS**

1. **Civil Drawings Series**
   a. 100 Title Sheet
   b. 147 Existing Features Plan
   c. 148 Construction Plan
   d. 148.1 Site Details & Profile
   e. 148.2 Grading Plan
   f. 148.3 Grading Details & Profiles
   g. 148.5 Drainage & Utility Plan
   h. 148.6 Landscaping Plan & Details

2. **Architectural: "A" Series**
   a. A100 Architectural Site Diagram
   b. A100.1 Exterior Site Slab Diagram
   c. A103 Construction Types
   d. A108 Equipment & Blocking Plan
   e. A111 Entry Plan, Elevations & Details
   f. A113 Site Details
   g. A114 Signage Details
   h. A200 Building Elevations
   i. A406 Typical Stair Details
   j. A500 Roof Plan
   k. A504 Roof Penetration Details & Lightning Protection Details
   l. A703 Enlarged Plans & Int. Elevations
   m. A704 Enlarged Plans & Int. Elevations
   n. A705 Enlarged Plans & Int. Elevations
   o. A708 Enlarged Plans & Int. Elevations
   p. A709 Enlarged Plans & Int. Elevations
   q. A711 Enlarged Plans & Int. Elevations
   r. A800 Reflected Ceiling Plan

s. A801 Enlarged Ceiling Plans & Details

3. **Mechanical: "M" Series**
   a. M701 Mechanical Schedules
   b. M702 Mechanical Schedules
4. **Electrical: "E" Series**
   a. E001 Electrical Legend, Abbreviations, and General Notes
   b. E002 Site Plan Electrical New Work
   c. E003 Site Plan Lightning Protection New Work
   d. E101 First Floor Plan Power
   e. E102 First Floor Plan Mechanical Power
   f. E103 First Floor Plan Fire Alarm
   g. E201 First Floor Plan Lighting
   h. E301 Part Floor Plans Electrical
   i. E401 Electrical Details
   j. E402 Electrical Details
   k. E501 Electrical One-Line Diagram
   l. E601 Lighting Fixture Schedule
   m. E602 Panel Schedule
   n. E603 Panel Schedule
5. **Electrical: "AL" Series CAD Alerting System**
   a. AL-100 Cover Sheet
   b. AL-101 General Requirements
   c. AL-102 Alerting Diagram
   d. AL-103 Alerting Wiring Diagram
   e. AL-104 Alerting Wiring Diagram
   f. AL-105 Typical Details & Display Diagram

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 1320 – CONTRACT PACKAGE SUPPLEMENTARY INSTRUCTIONS AND REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY
- A. This Section includes both general and specific requirements and instructions for each Contract Package

1.2 PROPOSALS
- A. Proposals in compliance with "THE INVITATION TO BID" and "THE INVITATION TO BID NOTICE: CUMRU FIRE DEPARTMENT" will be received for the Contract packages indicated within these Contract Documents.
- B. All proposals for the designated Contract Packages must include all equipment, material and labor to complete the Work of each Contract Package. **NO EXCEPTIONS, EXCLUSIONS OR QUALIFICATIONS ARE PERMITTED.**

1.3 CONTRACTORS BIDDING MORE THAN ONE PACKAGE
- A. Contractors bidding more than one Contract Package must submit separate and complete forms for each package as required by "THE INVITATION TO BID" and "THE INVITATION TO BID NOTICE: CUMRU FIRE DEPARTMENT".

1.4 BID PACKAGE INSTRUCTIONS AND REQUIREMENTS
- A. **GENERAL SCOPE (ALL CONTRACTORS)**
  1. See the following APPENDIX A
- B. **1A – GENERAL CONTRACT**
  1. See the following APPENDIX B
- C. **15A – MECHANICAL CONTRACT PACKAGE**
  1. See the following APPENDIX C
- D. **15B – PLUMBING CONTRACT PACKAGE**
  1. See the following APPENDIX D
- E. **16A – ELECTRICAL CONTRACT PACKAGE**
  1. See the following APPENDIX E

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 011320 – APPENDIX A

GENERAL SCOPE OF WORK (ALL CONTRACTORS)

This General Scope of Work applies to all contractors working on the Cumru Fire Department. The scope of work shall include the following items as they apply to the work in each contract unless specifically noted otherwise in the specific scope requirements.

1.1 Owner will provide a land surveyor to establish benchmarks and control points for construction of building foundation, column lines, and site improvements. Each contractor is responsible for all other building interior layout needs. Each contractor is responsible for providing and updating a schedule and scope for construction surveying services at least 5 (five) workings days prior to the date the survey is needed.

1.2 For survey work not provided by Owner provided land surveyor; Contactor is to provide layout/stakeout as required to perform their Work. Initial vertical control (at minimum of two locations on site) will be provided as part of the specific scope of work under one of the Contract Packages. Contractor shall take precautions when completing layout work by thoroughly verifying sizes and locations of proposed equipment, services and building components such as walls, ceilings, etc. The Contractor shall review and compare multiple strings of dimensions, when shown in the drawings, to minimize layout and drawing discrepancies. Ambiguities, errors, or any inconsistency in the drawings shall be brought to the attention of the Architect. Each Contractor is responsible for reviewing information/literature on equipment being supplied by other Contractors and the Owner in order to coordinate the completion of the work.

1.3 Core drilling, cutting and patching as required to perform work. Include restoration of surfaces to original condition. Cutting to be performed as to minimize patching.

1.4 Sealants, caulking and fire-stopping integral with work. In the process of planning its work each Contractor shall review the Contract Documents to determine the location of the fire rated/smoke type partitions and the full height walls. The Contractor shall locate pipes, ducts, conduits, etc. in order to minimize interference with these walls.

1.5 Permit fees, licenses, testing and inspections required for work. The Owner will be responsible for obtaining and paying for the general (non-trade specific) building permit. Each Contractor shall arrange inspections and tests, coordinate and cooperate with the testing agency and provide assistance as specified. Provide at least 48 hours notice to the testing agency prior to requiring the testing agency on site. Each Contractor shall arrange for the required permit inspections by the governing authorities during the course of completing its work. The 1A Contractor shall arrange for Final Occupancy Inspection. Fines associated with non-compliance with said permits and approvals shall be the responsibility of the contractor. Testing for soil compaction, structural steel and concrete will be performed by an independent testing agency under contract of the 1A – General Contractor.

1.6 Daily and final cleanup including mud and dirt tracked onto public walks, lots and roads. Good housekeeping is essential to the safe and efficient construction of the job and is the responsibility of each foreman and his crew. Work areas, stairways, walkways, storage rooms, staging areas, office areas, and other areas shall be kept clean of obstructions, paper, scrap, pipe, lumber, welding rods, rags, and other debris at all times. Wash tires at wheel wash station prior to leaving site.

1.7 Removal to dumpster(s) all trash and debris generated by this work (unless noted otherwise in the specific scope of work). Each contractor is to deposit their trash and debris into dumpsters provided by the 1A Contractor based on the type of trash such as concrete/masonry, wood, metal, asphalt, gyp board and paper. The 1A Contractor will be responsible for all waste removal from the site and recycling where required.

1.8 Unloading, hoisting, and maintenance of traffic.

1.9 Contractor shall be required to conduct his activities in a safe manner and shall be responsible for observing the safety requirements of OSHA and local life safety agencies.

A. Comply with all applicable laws, ordinances, rules, regulations, and orders of the governing authorities having jurisdiction for safety of persons and property to protect them from damage, injury and/or loss.
B. Erect and maintain as required by conditions and progress of the work, all necessary safeguards for safety and protection, including fences, railings, barricades, lighting, posting of danger signs and other warnings against hazard.
C. Be solely responsible for initiating maintaining and supervising all safety precautions and programs in connection with the project.
D. Where noxious or nuisance fumes and odors occur due to construction processes, the contractor shall take every precaution to inform occupants of adjacent buildings and shall take every precaution to prevent the fumes or odors from penetrating the adjacent building. Precautions may include but are not limited to sealing vents and louvers and providing fans to direct odors away from the occupied areas. Contractor shall coordinate with the Owner minimum of 72 hours prior to beginning such processes.

1.10 Temporary lighting, power and water for Contractor's trailers. Temporary lighting within the building beyond what is provided by the 16A Contractor.

1.11 Temporary heating or air conditioning prior to the startup and use of the permanent HVAC system.

1.12 Scaffolding, lifts, cranes and other means of access for own work. In accordance with applicable codes and regulations, all hoisting equipment used on site shall have routine maintenance and inspections. Copies of the inspection certificates are to be maintained with the equipment and shall be provided to the Owner, Architect, or AHJ when requested.

1.13 Temporary staging, storage, and office facilities including utilities (and monthly service) for same.

1.14 Excavation, backfill, compaction, shoring and normal mucking/dewatering for own work. Haul off-site excess spoils. Contractor to provide dust control for his work. Contact PA One Call prior to any excavation work.

1.15 Premium costs for shutdowns or any other off-hour work. All shutdowns must be scheduled at least one (1) week in advance with the Owner.
1.16 Phasing and remobilizations based on the agreed upon project schedule and as required to properly coordinate and complete the work.
1.17 Temporary protection of new and existing work from damage by own work.
1.18 Field measurements and verification of existing conditions and elevations. The Contractor shall promptly notify the Architect whether or not proposed dimensions are required to be guaranteed to ensure timely delivery of materials. If there is a conflict between drawings or specifications, the contractor is responsible for the most costly option.
1.19 Temporary weather and dust protection for own work.
1.20 Compliance with local noise restrictions.
1.21 Temporary sheeting, shoring and bracing as required to perform the work.
1.22 MSDS sheets for all materials must be submitted with the submittals and prior to start of work.
1.23 Shop drawings, submittals and mock-ups as specified. The Contractor will submit for approval all shop drawings and data as required by the specifications. Project work, materials, fabrication, and installation shall conform to the requirements of the Contract Documents, corrected shop drawings, applicable samples, and catalog data. No submittal will be reviewed by the Architect, unless it has been reviewed and approved by the Contractor and bears evidence of such approval. Submittals made without evidence of Contractors review and approval will be returned to the Contractor without comment.
1.24 Warranties specified commencing on date of substantial completion. Warranty extensions to comply with the warranty period starting on the date of substantial completion shall be the responsibility of the Contractor to ensure full specified warranty from the date of substantial completion.
1.25 As-built drawings, O&M Manuals, commissioning tests and all other required closeout documentation. Provide electronic files in pdf file format.
1.26 Reproduction costs for Contract Documents and shop drawings.
1.27 Insurance per Owner Contract.
1.28 Professional liability insurance for any design/engineering work.
1.29 All applicable sales, use and excise taxes.
1.30 Performance and Payment Bonds as required by the Township of Cumru.
1.31 Surface preparation and inspection for proper installation of this work. Include cleanup, etching, flash patching, moisture testing, etc. as required per specifications and manufacturer's instructions. Commencement of this work shall constitute acceptance of the substrate as suitable for this work.
1.32 Control wiring required for equipment provided as part of this work and not specified elsewhere in the Contract Documents.
1.33 Concrete required for the work which is not detailed on the architectural or structural drawings (e.g. equipment pads, thrust blocks, inertia pads, duct banks,, etc.)
1.34 Sleeves inserts and anchors for the work
1.35 Additional reinforcements/supports for the work which are not detailed but required for proper installation of the work.

1.36 Abide by all directions of the Fire Department or AHJ in matters affecting life safety and fire prevention for the work.

1.37 Temporary barricades shall be placed and maintained by the contractor creating the hazard, or when necessary to facilitate the next sequence of construction. The contractor shall be responsible for the next sequence of construction is then responsible for the barricades if a hazard still exists. Contractors who disturb the barricades shall restore them to meet safety requirements, at their own expense. The foregoing "barricades" applies equally to all safety, weather and dust protection provisions. The Owner shall have the right to determine the suitability of the barricades. Contractors creating a floor/roof opening fall hazard will provide plywood covers over the opening, per OSHA standards, and install warning signs on the cover. Remove cover after hazard does not exist. Daily inspection and documentation of covers will be by the contractor that created the penetration.

1.38 Normal working hours for this project shall be Monday through Friday 7:00 AM to 5:00 PM. (Working other hours will require authorization by the Owner.)

1.39 Full time competent on-site supervision is required by all contractors during the performance of own work. In the case of contracts involving second tier subcontractors, the Primary Contractor will provide on-site supervision and coordination of their subcontractors and direct hire work. The contractor will be back-charged for time spent performing such coordination by the Owner, if it does not occur.

1.40 Submit daily work reports indicating number of workers by classification, work completed, and hours worked.

1.41 **Attendance of bi-weekly progress meetings is required by all contractor's project managers. A line item will be required for this activity within the schedule of values and will not be approved for progress billing without Owner approval that this task was completed and acceptable.**

1.42 Contractors to hold weekly safety meetings and maintain meeting minutes on site for reference by Owner, Architect or AHJ at any time.

1.43 Refer to all other project specification sections for additional scope requirements.

1.44 Portable toilets shall be provided by the 1A Contractor.

1.45 Construction personnel shall use designated entrance and egress areas to the project site as directed by the Owner. Contractor is responsible for parking of own personnel. Contractor's will not be permitted to park within Owner parking areas unless first obtaining permission from the Owner. Contractors shall not block or impede entry roads, drives, or other pedestrian or vehicular paths.

1.46 The cost of repairs to any permanent or temporary work in place or existing finishes will be borne by the Contractor responsible for the damage. Incidental construction damage to each Contractor's work and/or equipment shall be repaired by the installing/providing Contractor who shall assume the cost of such repair. If responsible parties for the incidental damage can be identified, cost shall be borne by them accordingly.

1.47 The Contractor will comply with all local codes, ordinances, regulations, etc. as may be required by the Township of Cumru, Berks County, the state of Pennsylvania and/or any local authority having jurisdiction.

1.48 After pouring concrete, contractor shall wash out trucks and pumps in an on-site wash pit. Wash water must not enter storm-water system.

1.49 SCHEDULE

A. 1A – General Contractor shall be responsible for developing, managing and maintaining the overall project schedule. The project schedule shall be established and updated by the Contractor by coordinating the schedules developed by each Prime Contractor (1A, 15A, 15B, and 16A) to complete their Work. Each Prime Contractor must coordinate their schedule with the 1A General Contractor and the project schedule. The schedule shall be established so that conflicts are avoided and that the expeditious progress of the project is not hampered. **Major coordination milestones shall be included within the schedule as separate items.** Upon completion and distribution of an overall project draft schedule to all Prime Contractors, the Architect and the Owner, each Prime Contractor must complete, sign and return to the Architect and Owner a "Project Schedule Acceptance Form" within five (5) business days of receipt of the schedule. The Contractor shall update the overall project schedule on a monthly basis and distribute the revised overall project schedule at every other progress meeting.

B. Non-compliance by any Prime Contractor with the agreed upon schedule that results in delays of the project schedule and results in additional time expenditure and/or additional Work for any other Prime Contractor shall result in a Change Order to the offending Prime Contractor. It shall be the responsibility of the affected Prime Contractors to provide proof of delay resulting in additional time and Work as back-up upon issuance of a Change Order Request for the delay caused by another Prime Contractor. The Change Order Requests accompanied by acceptable back-up from the affected Prime Contractors shall be the basis to establish the Change Order issued by the Township of Cumru to the offending Prime Contractor.

C. All work, or applicable portions of the work, shall be sufficiently complete as required for Owner's fit- out, use and occupancy and all required approvals and permits for use and occupancy shall have been issued by the appropriate authorities by the established "Date of Substantial Completion" of the work, or applicable portion thereof.

D. All punchlist work, and project closeout shall be completed and approved by the Owner and Architect by the "Date of Final Completion" which shall be no later than thirty (30) calendar days (or earlier per specifications) after the Date of Substantial Completion. Any uncompleted punchlist items after this date will be completed by the Owner and back-charged to the appropriate contractor or vendor including time and expenses spent by the Owner to complete the Work. Final invoices will not be processed until final completion of the work and certification of same by the Owner and the Architect.

E. The Owner and the Architect will monitor the progress of the Work and will meet and confer with the contractor to determine whether or not they are on schedule. If the Owner and the Architect determine that the contractor is not on or ahead of schedule:

1. The contractor will be notified that they have fourteen (14) calendar days to expedite their work to get back on the schedule.
2. The Township of Cumru will not make any further payments until the contractor is back on schedule.

F. If at the end of fourteen (14) days the contractor is still not on schedule, they and their bonding company will be notified that they are in imminent Breach of Contract and the Township of Cumru will obtain the work on the open market. The Township of Cumru will deduct the amount charged by the alternate company from any monies due to or which may become due from the contractor.

G. Contractor will provide copies of a submittal schedule to all other contractors, the Owner and the Architect in conjunction with and coordinated with the overall project schedule.

1.50 Contractor will provide copies of approved shop drawings to other contractors that require coordination with the work.

1.51 Contractor shall protect finished/sealed floors and concrete floors not receiving finishes with Masonite or plywood when working off of ladders, scaffolds or other equipment, and when performing tasks with materials that may stain or otherwise compromise the look of the exposed surface. Contractors shall only use easily removable marking utensils and materials where necessary to mark on exposed surfaces and shall be responsible for removing such markings prior to completion.

1.52 Contractors shall provide mock-ups as indicated in the specifications and scope of work.

1.53 Contractor is responsible for his scope of work throughout all of the Contract Documents.

1.54 The word "provided" means purchased, delivered, and installed.

1.55 The word "furnished" means purchased and delivered.

1.56 Each Contractor is responsible for providing fans and temporary ducting to remove odors and fumes as a result of completing his work, such that all trades can continue to work in the space.

1.57 As-builts will be kept by each contractor individually. Each contractor will also be required to input As-built information into the record set kept in the 1A General Contractor's trailer on a weekly basis. A line item will be required in the schedule of values for this activity and will not be approved for progress billing without Owner approval that this task has been completed.

1.58 Contractor must maintain sufficient manpower to meet schedule and avoid delay to other phases or contractors.

1.59 If there is a conflict between drawings, specifications, and/or scope of work, the Contractor will be responsible for the most costly option

1.60 All applicable taxes, necessary permits, delivery fees, and travel time/expenses are to be included in the base bid.

1.61 Contractor will meet, at a minimum, the insurance requirements as indicated by the Township of Cumru.

1.62 Contractor is responsible for coordinating with all other trades so that conflicts are avoided and the expeditious progress of the project is not hampered. Any

contractor who believes that a potential conflict exists shall notify the Architect immediately and follow up in writing within three (3) business days.

1.63 In the event of an overlap of individual scopes, all parties referenced are responsible for completing the work and the Owner reserves the right to request a credit from the contractor(s) who does not provide the work.

1.64 Contractor must provide full-time, on-site supervision during all phases of the work described in their individual scope of work. Supervisors shall be fluent in the English language and be able to communicate daily with Owner, Architect and other Contractors.

1.65 Each Contractor shall be responsible for performing any required earthwork, excavation, trenching, and backfilling to complete the work identified within their scope of work.

1.66 Earth Moving: All contractors performing earthwork, excavation, trenching and/or backfilling to complete their work shall comply with the following:

A. Contractor shall be responsible for all earth moving activities required to complete the Work of their contract. Contractor shall be responsible for reviewing and understanding the Geotechnical Report provided within Section 003132 "Geotechnical Data" and 003132a "Geotechnical Report".

B. The base bid shall include all earthwork, excavation, trenching, and/or backfilling required to perform the work indicated within this contract based upon a pad site prepared under a separate contract. The pad site shall have been brought to subgrade elevation 539.00' within the building pad and exterior pads, drives paving areas, patio areas and within 3 feet of the final proposed building footprint. The prepared building pad area shall consist of approximately 2-3 feet of #57 stone or PenDot 2A fill material, and the sub base directly below the fill material shall have been compacted to meet the contract requirements or geotechnical recommendations as indicated within the Geotechnical Report (003132a).

C. Contractors preforming earthwork, excavation, trenching, and/or backfilling shall provide within their base bid, all Work required to comply with the project requirements and geotechnical Report (003132a) recommendations to accommodate or remediate the soil conditions indicated within the Contract Documents and the Geotechnical Report (003132a) or that are reasonably inferable from the Geotechnical Report (003132a).

D. Contractors performing earthwork, excavation, trenching, and/or backfilling shall reference 00 33119 Existing Condition Information for previously documented record of existing pad work performed.

E. All earthwork, excavations, trenching, and backfilling shall be tested by an Owner provided geotechnical engineer/testing agency. Compaction requirements shall be as specified/indicated within the Contact Documents or as recommended/indicated within the Geotechnical Report (003132a). Unsuitable soils beyond those indicated/identified or reasonably inferable from the Geotechnical Report (003132a) shall be identified by the Owner provided engineer/testing agency. Remediation of unsuitable soils shall be as recommended by the Owner provided geotechnical engineer and approved by

the Architect. The Owner provided geotechnical engineer shall present the remediation solutions in writing to the Architect for approval.

F. Contractor performing earthmoving, trenching, or other excavations shall be responsible for all dewatering operations for their Work.
G. Contractors performing excavation protection to prevent sidewall instability issues and conforming with OSHA Excavation Safety Standards. Design, implementation, and maintenance of such protections shall be the sole responsibility of the contracting performing such Work.

END OF APPENDIX A

SECTION 01 1320 – APPENDIX B

CONTRACT PACKAGE 1A – GENERAL CONTRACT PACKAGE

This work shall include all labor, supervision, material, tools, equipment, shop drawings, submittals, layout, unloading, scaffolding, ladders, hoisting, transportation, taxes, permits, engineering, support functions, insurance, bonds, and any other items or services necessary for and reasonably incidental to the proper execution and completion of the work, whether temporary or permanent, in accordance with all drawings, specifications, addenda, general conditions, requirements, and other related documents as indicated herein and/or within Section 011300 – CONTRACT PACKAGE DOCUMENT REFERENCE and/or within the project contract and/or procurement documents.

1.1 Scope of Work:

A. Contractor shall be responsible for completing all Work indicated within the contract documents unless specifically indicated to be part of another contract package. See applicable specification sections and drawings: Refer to Section 011300 – Contract Package Document Reference
   1. Where work is indicated under more than one contract package, the Work shall be completed by one of the contractors and credit shall be provided by the other contractor. The Owner shall decide which contractor completes the work scope and which Contractor(s) will be required to provide a credit to the Owner.

B. NOT USED

C. Temporary Facilities: The contractor shall provide all temporary facilities required to complete the scope of work of this contract package that are not specifically provided for under another contract package scope. Additionally the contractor shall be responsible for providing the following for use by Owner, Architect and all other prime contractors:
   1. Contractor must provide sufficient waste containers to meet the project schedule and to avoid delay to other contractors and phases of work. Contractor shall promptly remove and replace waste containers as required to maintain the schedule and work flow.
      a. Contractor shall be responsible for complying with all permit conditions. Any fines associated with non-compliance with said permits and approvals shall be the responsibility of the Contractor.
      b. Contractor will be responsible for monitoring, scheduling, administering, and recording container pulls from site. Empty containers must be available upon removal of existing, full containers so as not to impact the building construction activities. Any double handling of waste or delay in building activities due to container removal/placement will be the responsibility of this contractor.
   2. Contractor must provide sufficient portable toilet facilities for the use of personnel of all contractors on site. Contractor shall maintain these facilities in

a clean and sanitary condition. Contractor shall be responsible for monitoring and scheduling change over, cleaning and pumping of facilities on a regular basis. The Owner reserves the right to require additional toilet facilities if quantity is deemed insufficient by them. Additional toilet facilities shall be provided at no additional cost to the contract.

3. Contractor shall provide a job site trailer for use by the Owner, Architect and other Contractors for the purpose of various job meetings, Contractor As-built coordination/maintenance, and other required activities.
    a. Trailer shall be large enough to hold up to 12 individuals seated around a conference table, provide hanging plan storage for each separate contract package, and provide a plan table large enough to support two sets of plans or a single set of open plans.
    b. The Contractor shall be responsible for providing furnishings within the trailer as follows:
        1. Conference table that seats 12 persons
        2. Chairs for 12 persons
        3. Plans rack and plan holders for each separate contract package as well as the project As-built set.
        4. Plans table.
        5. Tack strip or board(s) sufficient to hang project schedule, calendar, finish boards(two 24x36 boards), and architectural renderings (4 24x36 boards).
    c. The trailer shall have the following characteristics or provisions at a minimum:
        1. HVAC
        2. Single point power connection to power pre-wired electrical components. (outlets, lights, HVAC equipment, etc.)
        3. Stairs (A handicapped accessible ramp shall be provided where required by the AHJ.)
    d. Maintenance of trailer and scheduling of its use shall be the responsibility of this contractor.

D. Overall project schedule.
E. Progress Photos: Each Contractor must submit on a weekly basis and when requested by Owner or Architect daily progress photos of the work being performed. Additional photos of questioned items or in place construction or existing conditions may be requested by Architect at any time without additional cost to the contract. A line item will be required for this activity within the schedule of values and will not be approved for progress billing without Owner approval that this task was completed and acceptable.
F. Contractor shall provide layout/stakeout as required to perform work of this contract package. Control points shall be maintained throughout the duration of the project. If for any reason control points are disturbed or need to be re-established, this contractor shall be responsible to perform this work at no additional cost to the contract.

1. This contractor shall employ a licensed third party surveyor to provide all site and building surveys, including but not limited to benchmarks (2 minimum), property corners (all), limits of disturbance (all), building corners (all), and horizontal and vertical control. Building column line offsets (in two directions) and elevation monuments, for horizontal and vertical control, to be provided at four locations after the pad prep is complete. Provide the final as-built survey upon completion of the work.
2. Provide progress and final surveys, certifications, and documentation of stormwater management facilities as required by the AHJ.
3. Excavation, furnish, install, and backfill required to provide keystone retaining wall as indicated in the contract documents in entirety. All wall material, reinforcement, footings, bracing, drainage, waterproofing, etc. to be provided for installation of complete system. Backfill of wall to be per manufacturer's recommendations with equipment that will not jeopardize the structural integrity of the wall. This includes walk-behind and hand operated equipment, if necessary, to obtain passing compaction results.

G. Contractor shall be responsible for all sediment and erosion control (S.E.C.) work.
1. Provide all S.E.C. measures including but not limited to construction entrances, traps, removable pumping stations, fences around traps, earth dikes, check damns, silt fence, piping, culverts, temporary seeding, etc. Work shall be done to satisfy the contract documents and all authorities having jurisdiction.
2. S.E.C. maintenance for the duration of the project and removal of all SEC items at the end of the project. Contractor to do daily inspections and maintain a log book of inspections. Set up, maintain for duration mentioned above, and removed at the end of the project (or earlier if allowed and approved by Owner and all AHJ's, a tire wash station at a location designated by Owner including water source, hose, valves, backflow prevention, and traffic bearing grating. Set up and maintain for the duration of the project and remove at the end of the project, a concrete wash-out pit at a location designated by the Owner. Maintenance of the pit to be included with weekly cleanout and removal of wash out material. Inlet protection is to be provided and maintained prior to and after the installation of paving and the duration of the project.
3. Contractor shall clean adjacent streets and parking areas of tracked out materials.
4. Conversion of sediment basin to permanent SWM usage. SWM facilities as-built survey required by this contractor. Maintain and rework SWM system until certification is received by AHJ. Haul all sediment off-site for disposal by this contractor. Complete all work associated with bio-retention/SWM/rain-garden facilities. This work includes but is not limited to excavation, haul-off, under drain pipe, stone, plant media, mulch, gabions, and plant material.
5. Contract shall protect wetlands and forest buffer as required.

H. Contractor shall perform all earthwork activities required to complete the project with the exception of trenching and backfilling for site utilities provided by other contract packages.

1. Clear and Grub portions of the site not cleared as part of the previous contract/pad site project.
2. Strip/Stockpile topsoil and haul off site any excess. Screening, placement, and grading of topsoil. Soil amendments shall be documented by third party engineer and quantities surveyed by a professional surveyor. Truck counts or other indefinite methods of quantifying soil remediation will not be acceptable and payment will be withheld for the Work. Reports shall be submitted documenting both remediation technique and quantities. Quantity of amended soils and remediation shall be completed and payment for such activities shall be based upon established unit pricing and estimated contract amounts identified as separate line items within the approved schedule of values. Contractor shall be responsible for the amount of topsoil to be stripped, as assumed from the information provided in the contract documents and the geotechnical report(s). Import if there is insufficient quantity available on site or export if there is excess. Either activity shall not result in any additional cost to the Owner.
3. Provide grading and topsoil work as shown in the Civil Drawings. Perform cut fill as necessary. Rough grade to be within 0.2 feet tolerance of required elevation. Fine grade, proof roll, and level all subgrades; notify Owner and Architect of any corrective work required prior to commencing this work. Proof rolling to be done with a loaded tandem dump truck or as directed by the third party testing agency and/or specifications. Selective site demo as required for grading work. Contractor is responsible for all excess soil haul-off. Excavation, fill, grading. Import/export as required. Contractor is responsible for all soil excavation and remediation that can be reasonably inferred from the provided information with the Contract Documents and the Geotechnical Report(s). Unforeseen conditions requiring soil remediation shall be documented by third party engineer and quantities surveyed by a professional surveyor. Truck counts or other indefinite methods of quantifying soil remediation will not be acceptable and payment will be withheld for the Work. Reports shall be submitted documenting both remediation technique and quantities. Quantity of amended soils and remediation shall be completed and payment for such activities shall be based upon established unit pricing and estimated contract amounts identified as separate line items within the approved schedule of values. This also applies to trench excavating and backfilling not required under other contract packages. The building pad shall be compacted and graded a minimum of an additional five feet beyond the exterior edges of the footings. Contractor is responsible for working of soils including but not limited to mucking, aerating, discing, sealing, grading to drain, blading with machine, wetting, soil cementing, and/or undercutting, hauling off-site, and importing select offsite borrow per specifications.
4. Protect stockpiled backfill material from becoming unsuitable for its intended use. If material becomes unsuitable take necessary measures to bring it to within specifications or remove it and import new material at no additional cost to the Owner.

I. Site Utilities and Structures: Contractor is responsible for all site utilities and structures with the exception of site utilities and structures specifically indicated to be part of another contract package. Electrical distribution, data distribution, water supply distribution, sanitary and gas piping shall be provided under other contract packages
   1. Furnish and install site utilities that connect to the building to within 5 feet of the building line; storm water (piping, inlets, manholes, etc.) Provide all concrete work associated with utility work such as collars, thrusts blocks, bases, etc. All utility trenching and backfilling shall be inspected and tested by a third party testing agency.
   2. Obtain all inspections required by AHJ.
   3. Flush storm drain system and remove spoil or debris from site at substantial completion (or sooner if system contains soil and debris during course of completing the project.) Provide water, flush truck, and vacuum truck. This contractor shall adequately protect cleanouts, manholes/cover, etc. so they are not damaged by construction traffic on the site. This contractor should perform weekly inspections of protective measures to ensure they are functioning. It is the sole responsibility of this contractor to keep storm piping systems and structures clean from dirt and debris throughout the project. No additional compensation will be provided to flush/clean piping systems.
   4. Furnish project record documents accurately recording actual locations of piping connection and invert elevations and identify and describe unexpected variations in subsoil conditions and discovery of uncharted utilities. As-built drawings shall be prepared and sealed by a surveyor registered in the State of Pennsylvania.
   5. Contractor shall adjust frames, grates, covers as required to grades required.

J. Landscaping
   1. Trees, plants, shrubs and ground covers including mulching, staking, soil amendments and watering, per specifications.
   2. Seeding, mulching, erosion control measures and sodding. Seeding shall be provided at all disturbed areas of the site unless indicated otherwise.
   3. Subgrade preparation for lawns, trees, shrubs and ground cover.
   4. Fine grade topsoil in all areas to receive shrubs, plants and ground covers are to be installed.

K. Asphalt Paving and Site Concrete
   1. Asphalt and concrete paving and curb and gutters. Include all excavation, compaction, stone, mesh, joint sealants, expansion joints, etc. Contractor shall review proposed grades of sidewalks and paving to ensure conformance with handicap code requirements. Provide all concrete additives, hot water, ice, blankets, related protection, etc. necessary to complete work regardless of exterior temperature.

L. NOT USED

M. Contractor shall be responsible for cast-in-place concrete indicated within the Civil, Architectural, and Structural Drawings. Cast-in-place concrete and other cementitious materials indicated within all other drawings shall be the

responsibility the contractor that is responsible for the work of those documents. Contractor shall provide all concrete additives, hardeners, curing compounds and other surface treatments. Contractor shall be responsible to provide all concrete hot water, ice, blankets, related protection, etc. necessary to complete work through the year.

1. Contractor shall coordinate with all under slab utilities to ensure proper pier height. Contractor shall provide modified piers to coordinate with MEP elevations shown on MEP drawings. Contractor shall provide stepped footings (whether shown or not) for underground utilities.
2. Concrete shall be sloped to floor drains. Slope shall comply with all handicap regulations. No dishing at the floor drains will be acceptable; drains shall be adjustable and adjusted to the proper height to coordinate with the floor slope.
3. Coordinate with all other Contractors prior to pouring cast-in-place concrete to ensure all rough-ins, embeds, etc. are in place and properly located.
4. Items include but are not limited to equipment, conduits, piping, wiring, devices, plates, etc.
5. Contractor shall protect threaded embedded items to prevent bending, deformation, and corrosion.
6. Contractor shall set all sleeves, plates and other such embedded items that support or allow penetration through all cast-in-place concrete. Embedded items shall be provided by all contractors to the 1A Contractor for placement. The 1A Contractor shall not be responsible for setting/placing continuously run work within and/or undercast-in-place concrete such as piping, conduit and similar such items.
7. Contractor shall produce coordination drawings indicating all embedded items. Coordination drawings shall be provided to All contractors for review and coordination of their work. All contractors shall be required to sign the completed coordination drawings prior to the placement of cast-in-place concrete. This contractor shall keep the signed coordination drawings on file within the construction trailer at all times. Each Contractor shall have a separate line item within the Schedule of Values for coordination drawings. This item will not be approved for progress billing without Owner approval that this task was completed and acceptable.

N. Light pole bases shall be the responsibility of the 16A – Electrical Contractor.

O. Site Furnishings: Contractor shall be responsible to provide all site furnishings including but not limited to all bollards and associated concrete fill. Bollards may be indicated on Civil, Architectural, Structural, Mechanical, Plumbing and/or Electrical drawings.

P. Testing and Inspections: This Contractor shall be responsible for all testing and inspections for this project that is not specifically indicated to be a part of another Contract Package. The 15A, 15B and 16A contractors shall be responsible for the testing and inspections of their specific systems. Perform all testing and inspection services in accordance with the contract documents, local code requirements and applicable reference documents.

Q. NOT USED
R. Contractor shall be responsible for all unit masonry, grout, and all related accessories.
   1. Contractor shall be responsible for placing all masonry imbeds, anchor bolts, base plates, leveling plates, bearing plates, inserts, sleeves, clips, reglets, steel lintels, masonry reinforcing steel, and all other masonry embedded accessories as required to complete the project. Contractor shall be responsible for obtaining all embeds from other contractors and place those embedded items.
   2. Contractor shall coordinate with all other trades regarding built-in or embedded items. Contractor shall coordinate and confirm all masonry opening sizes that are required by other contractors. Contractor shall close in all ductwork penetrations, pockets, and openings after embedded items are installed and inspected. Once close in is complete, it shall be the responsibility of each contractor to fire seal/safe, caulk or otherwise seal the their Work to the masonry.
   3. Contractor shall tooth masonry as necessary to accommodate other trades. Remobilization and completing work shall be included within contract. This includes leaving out sections of walls for access of other trades to all areas of the project. Openings shall be coordinated with each contractor.
S. Contractor shall provide all building insulation, fire safing, fire stopping systems, and sound insulation associated with his work. Contractor shall provide non-combustible material at the top of masonry walls. Contractor shall fill deck flutes at all full height masonry walls.
T. Contractor shall provide all Division 5 items and work; structural steel sections and shop fabricated ferrous metal items, galvanized and prime painted, including beams, columns, joists, structural tubing, channels, angles, plates, bars, steel pipe, hung plates, closer plates, shim packs, slip critical connections, bolted connections, welded connections, girts, tension rods, shear connections, plate girders, gratings, stiffener plates, permanent steel bracing, base plates, nuts, washers, connectors, rods and fasteners.
U. Contractor shall provide all miscellaneous metal items to support his work. Other contractors shall be responsible for providing all hangers, rods, strut channel metal framing, and accessories to support and install their work. This Contractor shall obtain from other contractors all items to be embedded within CMU and Cast-in-place concrete that are required to support their work respectively.
V. Contractor shall be responsible for providing all pour stops and miscellaneous angles or plates required to complete the work whether shown on drawings or not. Miscellaneous steel may be indicated on "A" series drawings.
W. Contractor shall provide all carpentry work as required to complete the work of this Contract Package including but not limited to the following:
   1. Miscellaneous Rough Carpentry
   2. Casework/Countertops
   3. Paneling

4. In wall wood blocking for handrails, casework, art work, signs, toilet accessories, curtain tracks, kitchen equipment, draperies/blinds, equipment, tv brackets, etc. as shown and/or specified.
5. All wood shall be fire/weather treated to comply with applicable codes and AHJ.

X. Contractor shall provide a complete roofing system as specified including but not limited to all insulation, fasteners, accessories, cover boards, flashing, sheathing/decking, anchors, sealants, penetrations, and membranes. Contractor shall coordinate installation of all roofing accessories required to be purchased and installed by other Contractors. Contractor shall tie roofing assembly into items provided and installed by other Contractors.
   1. Contractor shall provide all roof flashing, counter flashing and termination bars.
   2. Contractor shall provide all crickets, tapered insulation and cant strips to provide all proper drainage from roof to gutters and downspouts.
   3. Provide all gutters, downspouts, scuppers, splash blocks, roof caps, extended flashings, fascias, clips, and brackets.
   4. Contractor shall provide coatings to separate dissimilar metals.
   5. Contractor shall provide all expansion devices, joint fillers and covers in roofing system. All items to provide watertight installation and tie-in with roofing systems are by this contractor. Pre-fab expansion joint and cover assemblies.
   6. Metal soffits, fascias, coping, trims, flashing, fasteners and accessories to make a complete watertight system.
   7. Perform water testing of roofing system at the direction of the Architect.
   8. At rooftop units provide temporary roofing material beneath the entire equipment footprint to maintain watertight conditions until curb and equipment are installed and flashed in. Temporary flashing of curbs may be required due to scheduling of mechanical work.
   9. Contractor shall clean roof daily of all debris.

Y. Contractor shall provide all hollow metal doors, hollow metal frames, hollow metal windows, hollow metal borrowed lights, wood doors, aluminum entrances/storefronts, curtainwall, door hardware, and door equipment in accordance with the Contract Documents.
   1. Frames located in concrete or cmu walls shall be fully grouted. Provide grout plates and stops whether called for within documents or not.
   2. Frames and doors shall be prepared to receive all hardware as indicated within contract documents
   3. Coordinate with 16A contractor to ensure that provisions are compatible with electrically operated hardware components. 1A Contractor shall be responsible for all low voltage connections of the door hardware. The 16A Contractor shall be responsible for providing power to and connecting to the individual power supplies provided and installed by the 1A Contractor.
   4. Provide all accessories, transformers, power supplies, harnesses, etc. for electric hardware as needed for a fully functional system.

Z. Contractor shall provide all overhead doors, operable partitions, folding doors, coiling doors/grilles, fire shutters, etc. as indicated. Any supplemental framing

shown on the drawings or required/recommended by the manufacturer including but not limited to structural tubes, angles, channels, etc,. shall be furnished and installed by this contractor.

AA. All door threshold types and sizes to accommodate and coordinate with the specified floor finishes.

BB. Contractor shall provide all exterior and interior glass/glazing, plastic glazing, security glazing, accessories, caulking, and sealants necessary to complete this scope of work and provide a weather tight building envelope.

CC. Furnish and install all brake metal, trim metal, wet seal, beam wrap, etc. as shown on documents. All material shall match adjacent curtainwall, storefront and glazing mullions or other adjacent metal finish. Coordinate color selection with Architect prior to material order.

DD. Where required for the completion of other trades, the contractor shall leave out and provide temporary enclosures within storefront to accommodate the installation of large items within the building. The contractor shall remobilize at a later date to complete installation of storefront and glazing. Coordinate with all other trades.

EE. Contractor shall furnish and install all drywall work as required by the Contract Documents, including but not limited to all gypsum board, light gage metal framing, sheathing, metal studs, soffits vents, acoustical, thermal and fire safing insulation acoustical sealants, sealant installation, drywall accessories, drywall ceilings, and all related work. Light gauge metal furring, framing, grids, straps, studs, resilient channels and accessories.

1. Contractor shall install all access panels provided by all other contractors.
2. Contractor shall provide all work associated with wall termination requirements, including but not limited to filling in flutes, fire tracks, insulation, caulking, sealants, non-combustible materials, drywall, deflection track, etc. as required to achieve a smoke or fire partition/barrier/wall.

FF. Contractor shall furnish and install all acoustical ceiling system work as required by the Contract Documents, including acoustical panel ceilings and acoustical tile ceilings, suspension systems, acoustical treatment, scrubbable moisture resistant panel systems, metal panels, and all other materials and accessories to provide all ceiling types as indicated in the contract documents.

GG. Furnish and install all caulking, joint sealants, and firestopping for this contract. Other Contractors shall be responsible for providing caulking, joint sealants and firestopping for their contract scope. Where caulking, joint sealants and firestopping are required between work of different contractors, the contractor installing work onto, into or through another contractors work shall be responsible for providing the required caulking, sealant or firestopping.

HH. Contractor shall furnish and install all flooring as required by the Contract Documents, including but not limited to all vinyl composition tile, resinous flooring, epoxy flooring, anti-static flooring, base, vinyl trim, slip resistant VCT, accessories, underlayments, transition strips, reducing strips, metal edges, thresholds, and rubber flooring.

1. Clean and wax entire VCT floor system with 5 coats of Green Clean Product wax prior to building turnover.
2. Floor preparations, floor leveling and patching of minor defects (1/4" and less in depth) in all substrates to receive tile or sheet products.
3. Provide temporary protection including 50% of all flooring surfaces to prevent damage until substantial completion. Temporary protection shall be in the form of masonite and kraft paper.

II. Ceramic tile
1. All ceramic tile for floors, walls, base and caps.
2. All specialty trim pieces including but not limited to metal edging, stops, coves and transitions and all ceramic trim pieces including but not limited to bullnose tiles, cove tiles, corners tiles and double bullnose tiles.
3. Adhesive and setting materials.
4. Wall and floor preparations, leveling, and patching of minor defects (1/4" or less) in all substrates to receive tile.
5. Attic stock.
6. Crack isolation and waterproofing membranes.

JJ. All painting and finishing of interior and exterior exposed surfaces including, but not limited to masonry, drywall, hollow metal frames and doors, access panels, railings, supports, structures, braces, exposed piping, exposed ductwork, exposed conduit, exposed structural steel, exposed metal deck, miscellaneous metals wood work and painted or coated floors as required by the Contract Documents. Contractor shall also furnish and install all priming, block filling, finish painting, traffic coatings, and high performance coatings, and multi-colored interior coatings as required by the Contract Documents.
1. This Contactor shall be responsible for cleaning all overspray from adjacent materials.

KK. Furnish and install all fire extinguishers and cabinets for use after substantial completion of the project. Contractor shall also provide fire extinguishers and plywood boxes for extinguishers as required by AHJ during construction. Construction use fire extinguishers shall not be used for final building. Final building extinguishers shall be new. All fire extinguishers and boxes utilized during construction shall be removed by this contractor.

LL. All signage as included within Division 10 and shown on drawings. Contractor shall be responsible for providing all necessary preparation and installation of the signage as required to install the signage as specified.

MM. Contractor shall provide all projection screens and necessary supports and support hardware required to support screens from structural steel above. Support from the ceiling grid will not be acceptable. 16A contractor will be responsible for powering devices from a single point. This contractor shall be responsible for providing and installing all low voltage and control wiring and control devices to operate projections screens.

NN. Contractor shall provide all miscellaneous specialties furnishings and equipment required by the contract drawings, including but not limited to, wall and door protection, toilet bath and laundry accessories, flag poles, residential

appliances, entrance floor mats and frames, simulated stone countertops, and miscellaneous equipment.

OO. Contractor shall install all lockers, benches, metal cabinets, and metal storage shelving as required by the contract documents.

PP. Contractor must coordinate solid fill for equipment attachments with the Masonry Contractor.

QQ. Contractor shall furnish and install all supports, bracing, clips, wood plates, anchors bolts, grounds, angles, strut channel framing and other support items required to complete the installation of work included within this contract package. Contractor shall be required to provide any miscellaneous or structural steel required but not detailed on the structural drawings to support work under this contract package.

RR. The contractor shall coordinate rough-in power requirements for all items included in this contact package with the 16A Contractor. All control wiring, integral wiring, and final connection to power source junction box(es) shall be executed by this Contractor. Any wiring required within any unit (between multiple internal fixtures etc.) will be the responsibility of this contractor.

SS. Rated and non-rated expansion joint covers and systems.

TT. Contractor shall provide all toilet partitions, toilet compartments, urinal screens and accessories including but not limited to, doors, brackets, anchors, hardware, hinges, shoes, and coat hooks.

1. Coordinate locations of required toilet and bath accessories to be attached to or within the toilet partitions.
2. Coordinate in field dimensions of space prior to providing shop drawings and again at three weeks prior to installing partitions.
3. Contractor shall be required to provide any miscellaneous or structural steel required but not detailed on the structural or architectural drawings to the partitions.
4. Brackets for installing the toilet partitions, compartments, screens, etc. shall be coordinated with the substrate and finish to which they will be mounted. Coordinate with architect prior to installation where brackets may fall between two or more finishes or substrates.

END OF APPENDIX B

SECTION 01 1320C – APPENDIX C

CONTRACT PACKAGE 15A – MECHANICAL CONTRACT PACKAGE

This work shall include all labor, supervision, material, tools, equipment, shop drawings, submittals, layout, unloading, scaffolding, ladders, hoisting, transportation, taxes, permits, engineering, support functions, insurance, bonds, and any other items or services necessary for and reasonably incidental to the proper execution and completion of the work, whether temporary or permanent, in accordance with all drawings, specifications, addenda, general conditions, requirements, and other related documents as indicated herein and/or within Section 011300 – CONTRACT PACKAGE DOCUMENT REFERENCE and/or within the project contract and/or procurement documents.

1.1 Scope of Work:

A. Contractor shall be responsible for completing all Work indicated within the contract documents unless specifically indicated to be part of another contract package. See applicable specification sections and drawings: Refer to Section 011300 – Contract Package Document Reference
   1. Where work is indicated under more than one contract package, the Work shall be completed by one of the contractors and credit shall be provided by the other contractor. The Owner shall decide which contractor completes the work scope and which Contractor(s) will be required to provide a credit to the Owner.
B. Temporary Facilities: The contractor shall provide all temporary facilities required to complete the scope of work of this contract package that are not specifically provided for under another contract package scope.
C. Each Contractor shall maintain appropriate facilities for their personnel with regards to environmental working conditions and as required by occupational safety regulations.
D. Contractor shall be responsible for complying with all permit conditions. Any fines associated with non-compliance with said permits and approvals shall be the responsibility of the Contractor.
E. Contractor shall maintain a set of as-built drawings and keep current. On a weekly basis the overall master as-built set kept within the 1A Contractors site trailer shall be updated to reflect the current as built conditions. Upon project closeout these individual and overall master as-built sets will be submitted to the Owner.
F. Contractor shall develop and maintain a project schedule. The initial schedule for each contractors work shall be provided to and coordinated with the 1A General Contractor. See Appendix A for additional information.
G. Progress Photos: Each Contractor must submit on a weekly basis and when requested by Owner or Architect daily progress photos of the work being performed. Additional photos of questioned items or in place construction or existing conditions may be requested by Architect at any time without additional

cost to the contract. A line item will be required for this activity within the schedule of values and will not be approved for progress billing without Owner approval that this task was completed and acceptable.

H. Contractor shall provide layout/stakeout as required to perform work of this contract package. Control points shall be maintained throughout the duration of the project.
I. Daily cleanup and removal of all trash and debris generated by the Work. Dumpsters will be provided by the 1A Contractor. Upon completion of each phase of work in any given area, the Contractor shall leave the area in a broom-clean condition.
J. Contractor shall clean adjacent streets and parking areas of tracked out materials.
K. Obtain all inspections required by AHJ.
L. Review equipment suppliers "recommended installation procedures" to assure that design complies with manufacturer's space clearances and clearances established by local authorities for maintenance and service.
M. Contractor shall be responsible for providing plenum rated materials or protective coverings acceptable to the authority having jurisdiction that provide non-plenum rated materials code compliant protection when installed within a plenum space.
N. Contractor shall provide all concrete work or other cementitious work shown or specifically referenced by detail on the mechanical contract documents, including but not limited to all equipment pads, concrete in roof curbs and housekeeping pads. Contractor shall provide all concrete additives, hardeners, curing compounds and other surface treatments. Contractor shall be responsible to provide all concrete hot water, ice, blankets, related protection, etc. necessary to complete work as scheduled regardless of exterior temperature.
O. Coordinate with all other Contractors pouring cast-in-place concrete to ensure all rough-ins, embeds, etc. are in place and properly located.
    1. Contractor shall provide to the 1A Contractor all sleeves, plates and other such embedded items that support or allow penetration through all cast-in-place concrete that are required to complete the work of this contract. This contractor shall be responsible for setting/placing continuously run work within and/or under cast-in-place concrete such as piping, conduit and similar such items.
    2. Contractor shall produce coordination drawings indicating all embedded items. Coordination drawings shall be provided to All contractors for review and coordination of their work. All contractors shall be required to sign the completed coordination drawings prior to the placement of cast-in-place concrete. Each Contractor shall have a separate line item within the Schedule of Values for coordination drawings. This item will not be approved for progress billing without Owner approval that this task was completed and acceptable.
P. Testing and Inspections: This Contractor shall be responsible for all testing and inspections for the work of this contract package that is not specifically indicated to be a part of another Contract Package. The 1A, 15B and 16A contractors shall

be responsible for the testing and inspections of their specific systems. Perform all testing and inspection services in accordance with the contract documents, local code requirements and applicable reference documents.

Q. Contractor shall be responsible for providing seismic design and required struts, bracing, and other accessories/structural components required to comply with seismic design requirements for all work included under the 15A contract package. Seismic design shall be a delegated design requirement of this contract.

R. The 1A Contractor shall be responsible for all unit masonry, grout, and all related accessories and shall be responsible for placing all masonry imbeds, anchor bolts, base plates, leveling plates, bearing plates, inserts, sleeves, clips, reglets, steel lintels, masonry reinforcing steel, and all other masonry embedded accessories as required to complete the project with the exception of continuously run piping and conduits. Contractor shall be responsible for supplying all embeds to the 1A contractor.
   1. Contractor shall coordinate with all other trades regarding built-in or embedded items. Contractor shall coordinate and confirm with 1A contractor all masonry opening sizes that are required by this contract package. 1A Contractor shall close in all ductwork penetrations, pockets, and openings after embedded items are installed and inspected. Once close in is complete, it shall be the responsibility of this contractor to fire seal/safe, caulk or otherwise seal the Work of this contract package to the masonry.

S. Contractor shall provide all building insulation, fire safing, fire stopping systems, and sound insulation associated with his work.

T. Contractor shall provide all miscellaneous metal items to support his work including but not limited to all hangers, rods, strut channel metal framing, and accessories, including, but not limited to, vibration isolation and seismic accessories. This Contractor shall supply the 1A contractor all items to be embedded within CMU and Cast-in-place concrete that are required to support their work.

U. Contractor shall be responsible for providing all pour stops and miscellaneous angles or plates required to complete the work of this contract package whether shown on drawings or not. Miscellaneous steel may be indicated on any drawing.

V. Contractor shall provide all carpentry work as required to complete the work of this Contract Package including but not limited to the following:
   1. Miscellaneous Rough Carpentry
   2. In wall wood blocking.
   3. All wood shall be fire/weather treated to comply with applicable codes and AHJ.

W. Contractor shall provide all roofing accessories required by this contract package. 1A Contractor shall tie roofing assembly into items provided by this contractor.

X. This contractor shall coordinate with other contractor's locations of new work that may need to be temporarily left out to facilitate the mobilization or installation of large equipment in order to complete the work of this contract.
Y. Contractor shall furnish to the 1A contractor all access doors/panels required for the completion of this work (with the exception of duct access doors). Contractor shall provide coordination drawings to the 1A contractor indicating placement of all access doors/panels. 1A contractor shall be responsible for installing all access doors/panels. Contractor shall coordinate access panels with building finishes and assemblies for proper type of panel/installation.
Z. Furnish and install all caulking, joint sealants, and firestopping for this contract. Other Contractors shall be responsible for providing caulking, joint sealants and firestopping for their contract scope. Where caulking, joint sealants and firestopping are required between work of different contractors, the contractor installing work onto, into or through another contractors work shall be responsible for providing the required caulking, sealant or firestopping.
AA. Contractor must coordinate solid fill for equipment attachments with the Masonry Contractor.
BB. Contractor shall furnish and install all supports, bracing, clips, wood plates, anchors bolts, grounds, angles, strut channel framing and other support items required to complete the installation of work included within this contract package including but not limited to vibration isolation accessories and seismic bracing and other seismic accessories. Contractor shall be required to provide any miscellaneous or structural steel required but not detailed on the structural drawings to support work under this contract package.
CC. The contractor shall coordinate rough-in power requirements for all items included in this contract package with the 16A Contractor and the 1A Contractor. All control wiring, integral wiring, and final connection to power source junction box(es) shall be executed by this Contractor. Any wiring required within any unit (between multiple internal fixtures etc.) will be the responsibility of this contractor.
DD. Cutting, patching, core drilling, sleeves and penetrations required.
EE. All escutcheons as required to complete the work.
FF. Permitting and fees other than grading and building permit.
GG. Demonstrations of all systems associated with this work shall be videotaped and turned over to the Owner. Recording to be on DVD with sign-in sheets also provided.
HH. Touch-up all damages to factory applied finishes.
II. Testing and balancing.
JJ. Vibration isolation for mechanical equipment, piping and ductwork.
KK. Contractor shall furnish and install all (mechanical and fixed) louvers, vents, etc. and associated sills, flashing, lintels and accessories including but not limited to insulated blank-off plates. Coordinate all openings for louvers, vents, etc. with 1A General Contractor and indicate on coordination drawings. Upon erection of wall systems/assemblies, Contractor shall promptly provide secure, weathertight temporary closures at louver openings, and maintain closures until permanent

louvers are installed. Louver colors to be chosen and approved by the architect. Architectural louvers will be by this Contractor where not installed within hollow metal doors.

LL. Prefabricated and built-in-place roof curbs (Note: Special curbs and supports required if roof is not level), including but not limited to, solid top pedestal curbs as indicated. This Contractor is responsible for all rooftop penetration and curb details in entirety as shown on bid documents in association with equipment, piping, etc. as provided by this contract package. All curbs and supports should be installed prior to the installation of the roofing. For any roof curbs that are not installed in advance of the roofing installation, the 15A contractor shall be responsible for all costs for the roofer to return and flash in the curb later. In any case, if the equipment is not installed at the same time as the curb, provide a watertight cover over the curb.

MM. All major equipment must be located in accordance with the drawings and all code requirements. Locate access doors to valves.

NN. Return for maintenance during Guarantee/warranty period as specified.

OO. Coordinate location of all materials/equipment above ceilings with other trades. Any conflicts must be resolved prior to the start of work. All equipment must be located in accordance with the drawings and all code requirements.

PP. Contractor shall immediately provide and maintain OSHA compliant, properly secured, and labeled protective covers over all metal deck floor and metal deck roof openings, and concrete slab openings left for this work. Contractor shall provide all additional cutouts of metal deck and metal roof deck where required for the complete installation of this work. This contractor will be required to perform daily monitoring of all fall protection to document and ensure it is in place and functioning properly.

QQ. Coordinate with the 16A contractor regarding motor starters for mechanical equipment. 16A contractor shall furnish all motor starters, contactors, safety switches, disconnect switches and controls not included within equipment packages furnished by this contractor. This contractor shall provide all capacitors for this work.

RR. Extended warranties for period of temporary usage during construction. All warranties as specified in the contract documents will start at the date of substantial completion. It is understood by this contractor that the HVAC system will be required to be started well before the date of substantial completion to provide interior conditioned space as required for the installation of work under other contract packages. Any and all warranty extensions will be the responsibility of this contractor to obtain and pay for.

SS. This Contractor to provide all lintels for their work.

TT. This contractor is responsible for all costs incurred by modifications due to discrepancies between approved equipment and basis of design equipment as shown on bid documents. Modifications include but are not limited to service modifications (electrical, plumbing, fire protection, etc.), structural modifications, and architectural modifications. All equipment power requirements to be reviewed by this contractor. A list of equipment requiring deviations from the

contract documents shall be submitted within ten (10) days after approved submittals are returned to the contractor.

UU. Change all filters and clean all units and ductwork just prior to equipment turnover to owner.

VV. Complete heating and air conditioning system including but not limited to, pre-packaged roof top units, pumps, piping systems, condensate lines controllers, radiation devices, heat pumps, unit heaters, duct mounted heating coils, convectors, ductless split system units, etc.

WW. Complete air distribution system including but not limited to all ductwork, vents dampers, fans, filters, sound attenuation, air devices, air-handling units, custom air-handling units, energy recovery units, fan coil units, plenums air terminal units, combustion fans, exhaust air valves, control units, outdoor air, exhaust fans and air measuring devices.

XX. Diffusers, grilles, registers, flashing, insulated blank-off plates. Sealant installation and any incidentals required to complete installation.

YY. Smoke detectors and beam detectors integral with this work (coordinate with 16A contractor- 15A contractor to install only.)

ZZ. Provide temporary heat and ventilation during construction utilizing permanent equipment once the building is fully enclosed. Temporary heat and ventilation shall be required for the installation of work by other contractors that requires a conditioned environment to be installed. Warranty shall be extended for this time period. (Provide temporary filters and maintenance during operation.)

AAA. Coordinate air and exhaust requirements for equipment being furnished by other contractors.

BBB. The 15A contractor shall provide starters included within equipment packages for equipment being furnished under this contract to the 16A contractor for installation/connection. Coordinate with specifications and 16A contractor.

CCC. Fire dampers or fire/smoke dampers where ductwork penetrates rated assemblies.

DDD. Motors and VFD's where noted. All VFD's for mechanical equipment to be furnished by the 15A contractor and installed by the 16A contractor. Changes in size due to requirements of unspecified/substituted equipment will be the responsibility of this contractor. Upon installation, all VFD's are to be protected with plywood enclosures with venting and filtration media to protect VFD's from construction dust and debris. It is to be understood that the mechanical equipment will be started at a point while the building is still under construction. Any cleaning repairs, replacements, etc. required to keep VFD's operational during this time period in "new" condition at the time of the building turnover, and/or required to keep and maintain warranties from the date of substantial completion, will be by this contractor in entirety.

EEE. Mechanical equipment pads below equipment by this contractor; interior and exterior.

FFF. All insulation required by the specifications drawings and governing codes for work of this contract package.

GGG. Install duct smoke detectors provided by 16A Contractor.

HHH. Complete temperature control system including all wiring. All equipment, conduit, wiring, boxes, controllers, tie-ins, etc. to be included, including but not limited to, computer stations, printers, etc. Any requirements to the controls system that are not specifically indicated within the 16A Contractors package (i.e. dedicated data jacks at mechanical equipment, controls cabinets, etc.) will be the responsibility of this contractor to furnish and install at no additional cost to the Owner.

III. All equipment to be provided to the Owner per the contract documents, including but not limited to computers, software, printers, software licenses, etc.

END OF APPENDIX C

SECTION 01 1320D – APPENDIX D

CONTRACT PACKAGE 15B – PLUMBING CONTRACT PACKAGE

This work shall include all labor, supervision, material, tools, equipment, shop drawings, submittals, layout, unloading, scaffolding, ladders, hoisting, transportation, taxes, permits, engineering, support functions, insurance, bonds, and any other items or services necessary for and reasonably incidental to the proper execution and completion of the work, whether temporary or permanent, in accordance with all drawings, specifications, addenda, general conditions, requirements, and other related documents as indicated herein and/or within Section 011300 – CONTRACT PACKAGE DOCUMENT REFERENCE and/or within the project contract and/or procurement documents.

1.1 Scope of Work:

A. Contractor shall be responsible for completing all Work indicated within the contract documents unless specifically indicated to be part of another contract package. See applicable specification sections and drawings: Refer to Section 011300 – Contract Package Document Reference
   1. Where work is indicated under more than one contract package, the Work shall be completed by one of the contractors and credit shall be provided by the other contractor. The Owner shall decide which contractor completes the work scope and which Contractor(s) will be required to provide a credit to the Owner.

B. Temporary Facilities: The contractor shall provide all temporary facilities required to complete the scope of work of this contract package that are not specifically provided for under another contract package scope.

C. Each Contractor shall maintain appropriate facilities for their personnel with regards to environmental working conditions and as required by occupational safety regulations.

D. Contractor shall be responsible for complying with all permit conditions. Any fines associated with non-compliance with said permits and approvals shall be the responsibility of the Contractor.

E. Contractor shall maintain a set of as-built drawings and keep current. On a weekly basis the overall master as-built set kept within the 1A Contractors site trailer shall be updated to reflect the current as built conditions. Upon project closeout these individual and overall master as-built sets will be submitted to the Owner.

F. Contractor shall develop and maintain a project schedule. The initial schedule for each contractors work shall be provided to and coordinated with the 1A General Contractor. See Appendix A for additional information.

G. Progress Photos: Each Contractor must submit on a weekly basis and when requested by Owner or Architect daily progress photos of the work being performed. Additional photos of questioned items or in place construction or existing conditions may be requested by Architect at any time without additional cost to the contract. A line item will be required for this activity within the

schedule of values and will not be approved for progress billing without Owner approval that this task was completed and acceptable.

H. Contractor shall provide layout/stakeout as required to perform work of this contract package. Control points shall be maintained throughout the duration of the project.

I. This Contractor shall perform all trenching and backfilling activities required to complete the work of this contract.
   1. Soil shall be striped and stockpiled temporarily. Contractor shall haul off site any excess. Soil amendments shall be documented by third party engineer and quantities surveyed by a professional surveyor. Truck counts or other indefinite methods of quantifying soil remediation will not be acceptable and payment will be withheld for the Work. Reports shall be submitted documenting both remediation technique and quantities. Quantity of amended soils and remediation shall be completed and payment for such activities shall be based upon established unit pricing and estimated contract amounts identified as separate line items within the approved schedule of values.
   2. Backfilling operations shall be sufficient to bring back to grade as shown on Civil Drawings. Base and fill shall be tested in accordance with the Contract Documents; notify Owner and Architect of any corrective work required prior to commencing this work. Contractor is responsible for all soil excavation and remediation that can be reasonably inferred from the provided information with the Contract Documents and the Geotechnical Report(s). Unforeseen conditions requiring soil remediation shall be documented by third party engineer and quantities surveyed by a professional surveyor. Truck counts or other indefinite methods of quantifying soil remediation will not be acceptable and payment will be withheld for the Work. Reports shall be submitted documenting both remediation technique and quantities. Quantity of amended soils and remediation shall be completed and payment for such activities shall be based upon established unit pricing and estimated contract amounts identified as separate line items within the approved schedule of values.
   3. Protect stockpiled backfill material from becoming unsuitable for its intended use. If material becomes unsuitable take necessary measures to bring it to within specifications or remove it and import new material at no additional cost to the Owner.

J. Site Utilities and Structures: This Contractor is responsible for all water supply distribution, sanitary distribution and gas distribution utility work outside of the building for this project. Stormwater site utilities shall be by the 1A general contractor. This Contractor shall be responsible for bringing all stormwater piping from the building to a point 5 feet outside of the building line. Electrical distribution and data distribution shall be provided by the 16A Contractor.
   1. Provide all concrete work associated with utility work such as collars, thrust blocks, bases, etc. All utility trenching and backfilling for this work shall be inspected and tested by a third party testing agency.
   2. Obtain all inspections required by AHJ.

3. Furnish project record documents accurately recording actual locations of piping connection and invert elevations and identify and describe unexpected variations in subsoil conditions and discovery of uncharted utilities.

K. Contractor shall be responsible for providing plenum rated materials or protective coverings acceptable to the authority having jurisdiction that provide non-plenum rated materials code compliant protection when installed within a plenum space.

L. Daily cleanup and removal of all trash and debris generated by the Work. Dumpsters will be provided by the 1A Contractor. Upon completion of each phase of work in any given area, the Contractor shall leave the area in a broom-clean condition.

M. Contractor shall clean adjacent streets and parking areas of tracked out materials.

N. Obtain all inspections required by AHJ.

O. Review equipment suppliers "recommended installation procedures" to assure that design complies with manufacturer's space clearances and clearances established by local authorities for maintenance and service.

P. Contractor shall be responsible for providing seismic design and required struts, bracing, and other accessories/structural components required to comply with seismic design requirements for all work included under the 15A contract package. Seismic design shall be a delegated design requirement of this contract.

Q. Contractor shall provide all concrete work or other cementitious work required by, shown or specifically referenced by detail on the plumbing contract documents, including but not limited to all equipment pads, thrust blocks and housekeeping pads. Contractor shall provide all concrete additives, hardeners, curing compounds and other surface treatments. Contractor shall be responsible to provide all concrete hot water, ice, blankets, related protection, etc. necessary to complete work regardless of exterior temperature.

R. Coordinate with all other Contractors pouring cast-in-place concrete to ensure all rough-ins, embeds, etc. are in place and properly located.
   1. Items include but are not limited to equipment, conduits, piping, wiring, devices, plates, etc.
   2. Contractor shall provide to the 1A Contractor all sleeves, plates and other such embedded items that support or allow penetration through all cast-in-place concrete that are required to complete the work of this contract. This contractor shall be responsible for setting/placing continuously run work within and/or under cast-in-place concrete such as piping, conduit and similar such items.
   3. Contractor shall produce coordination drawings indicating all embedded items. Coordination drawings shall be provided to All contractors for review and coordination of their work. All contractors shall be required to sign the completed coordination drawings prior to the placement of cast-in-place concrete. Each Contractor shall have a separate line item within the Schedule of Values for coordination drawings. This item will not be approved for progress billing without Owner approval that this task was completed and acceptable.

S. Testing and Inspections: This Contractor shall be responsible for all testing and inspections for the work of this contract package that is not specifically indicated to be a part of another Contract Package. The 1A, 15A and 16A contractors shall be responsible for the testing and inspections of their specific systems. Perform all testing and inspection services in accordance with the contract documents, local code requirements and applicable reference documents.
T. NOT USED
U. The 1A Contractor shall be responsible for all unit masonry, grout, and all related accessories and shall be responsible for placing all masonry embeds, anchor bolts, base plates, leveling plates, bearing plates, inserts, sleeves, clips, reglets, steel lintels, masonry reinforcing steel, and all other masonry embedded accessories as required to complete the project with the exception of continuously run piping and conduits. This Contractor shall be responsible for supplying all embeds to the 1A contractor.
    1. Contractor shall coordinate with all other trades regarding built-in or embedded items. Contractor shall coordinate and confirm with 1A contractor all masonry opening sizes that are required by this contract package. 1A Contractor shall close in all penetrations, pockets, and openings after embedded items are installed and inspected. Once close in is complete, it shall be the responsibility of this contractor to fire seal/safe, caulk or otherwise seal the Work of this contract package to the masonry.
V. Contractor shall provide all insulation, fire safing, fire stopping systems, and sound insulation associated with this work.
W. Contractor shall provide all miscellaneous metal items to support his work including but not limited to all hangers, rods, strut channel metal framing, and accessories including, but not limited to, seismic accessories. This Contractor shall supply the 1A contractor all items to be embedded within CMU and Cast-in-place concrete that are required to support their work.
X. Contractor shall be responsible for providing all pour stops and miscellaneous angles or plates required to complete the work of this contract package whether shown on drawings or not. Miscellaneous steel may be indicated on any drawing.
Y. Contractor shall provide all carpentry work as required to complete the work of this Contract Package including but not limited to the following:
    1. Miscellaneous Rough Carpentry
    2. In wall wood blocking.
    3. All wood shall be fire/weather treated to comply with applicable codes and AHJ.
Z. Contractor shall provide all roofing accessories required by this contract package. 1A Contractor shall tie roofing assembly into items provided by this contractor.
AA. This contractor shall coordinate with other contractor's locations of new work that may need to be temporarily left out to facilitate the mobilization or installation of large equipment in order to complete the work of this contract.
BB. Contractor shall furnish to the 1A contractor all access doors/panels required for the completion of this work. Contractor shall provide coordination drawings to

the 1A contractor indicating placement of all access doors/panels. 1A contractor shall be responsible for installing all access doors/panels. Contractor shall coordinate access panels with building finishes and assemblies for proper type of panel/installation. Coordination drawings shall be required to be approved by the Architect prior to installation of ANY portions of systems. Placement of valves and other accessible work shall be placed such that access doors/panels shall be set in an inconspicuous location.

CC. Furnish and install all caulking, joint sealants, and firestopping for this contract. Other Contractors shall be responsible for providing caulking, joint sealants and firestopping for their contract scope. Where caulking, joint sealants and firestopping are required between work of different contractors, the contractor installing work onto, into or through another contractors work shall be responsible for providing the required caulking, sealant or firestopping.

DD. Contractor must coordinate solid fill for equipment attachments with the Masonry Contractor.

EE. Contractor shall furnish and install all supports, bracing, clips, wood plates, anchors bolts, grounds, angles, strut channel framing and other support items required to complete the installation of work included within this contract package including but not limited to seismic bracing and other seismic accessories. Contractor shall be required to provide any miscellaneous or structural steel required but not detailed on the structural drawings to support work under this contract package.

FF. The contractor shall coordinate rough-in power requirements for all items included in this contract package with the 16A Contractor and the 1A Contractor. All control wiring, integral wiring, and final connection to power source junction box(es) shall be executed by this Contractor. Any wiring required within any unit (between multiple internal fixtures etc.) will be the responsibility of this contractor.

GG. Cutting, patching, core drilling, sleeves and penetrations required.

HH. All escutcheons as required to complete the work.

II. Identification devices (label and tags.)

JJ. Permitting and fees other than grading and building permit.

KK. Demonstrations of all systems associated with this work shall be videotaped and turned over to the Owner. Recording to be on DVD with sign-in sheets also provided.

LL. Touch-up all damages to factory applied finishes.

MM. All major equipment must be located in accordance with the drawings and all code requirements. Locate access doors to valves.

NN. Return for maintenance during Guarantee/Warranty period as specified.

OO. Coordinate location of all materials/equipment above ceilings with other trades. Any conflicts must be resolved prior to the start of work. All equipment must be located in accordance with the drawings and all code requirements.

PP. This Contractor to provide all lintels for their work.

QQ. This contractor is responsible for all costs incurred by modifications due to discrepancies between approved equipment and basis of design equipment as shown on bid documents. Modifications include but are not limited to service

modifications (electrical, plumbing, fire protection, etc.), structural modifications, and architectural modifications. All equipment power requirements to be reviewed by this contractor. A list of equipment requiring deviations from the contract documents shall be submitted within ten (10) days after approved submittals are returned to the contractor.

RR. All insulation required by the specifications drawings and governing codes for work of this contract package.

SS. Contractor shall protect all drains/cleanouts to prevent debris generated by other contractors from clogging drainage piping. Contractor shall be responsible for removing and cleaning off of protective materials.

TT. Contractor shall be responsible to receive, unload and store in weatherproof secure trailers and in a manner and location acceptable to Owner all items to be incorporated into the project.

UU. Review structural documents and coordinate pier and foundation elevations with 1A contractor so they do not interfere with under slab work.

VV. Job is bid as unclassified for all soil/rock conditions. Reference the geotechnical engineer report(s). Contractor is responsible for all subsurface conditions and costs associated with completing the work. Contractor shall haul and dispose offsite all excess soils and import suitable soils where required to complete the work.

WW. Provide all testing, sanitation and certification of systems.

XX. Contractor shall confirm and accept the subgrade elevation prior to beginning underground work. Commencement of underground work shall constitute acceptance of subgrade in the general area of the work. Contractor shall restore compacted subgrade to design elevation, including but not limited to removal of all earthwork spoils, immediately upon completion of underground work in any and all areas. Unsuitable material will be replaced with approved structural fill at no additional cost.

YY. Contractor shall provide all roof drain receivers.

ZZ. Contractor shall provide all sinks, and provide all connections to all sinks.

AAA. Plumbing systems complete including but not limited to sanitary, storm water/rainwater, leaders venting, gas, and air. Include all rodding , thrust blocks or other restraining devices required.

BBB. Include all piping, valves, fittings, fixtures, switches, hangers, anchors, supports, manifolds, control panels, outlets, boxes, pumps, receivers, ejectors, and other specialties and accessories.

CCC. Provide and maintain temporary water connections for use by all contractors. Water connection shall be extended from Owners existing water supply system and shall comply with AHJ requirements. Owner will be responsible for use charges.

DDD. Rough-in/final connection of domestic water, waste/vent and domestic water heating system.

EEE. Water heaters, water circulators, pumps. Verify that electrical supply per drawings is coordinated with the requirements for this equipment.

FFF. Drainage systems including but not limited to roof drains, floor drains, trench drains, etc.

GGG. The 15B contractor shall provide starters included within equipment packages for equipment being furnished under this contract to the 16A contractor for installation/connection. Coordinate with specifications and 16A contractor.

HHH. Downspout boots, interior and exterior.

III. Domestic water service detail per drawings, specifications, or local governing authority, whichever is most stringent. All equipment, valves, piping, backflow preventer, strainers, etc. to comply with local codes even if not shown on the drawings.

JJJ. Sanitary sewer piping into the building.

KKK. Plumbing systems including but not limited to under-slab sanitary, storm water (within building to a point 5 feet from building line), domestic water, air conditioning condensate, and natural gas or propane gas. Include all rodding, thrust blocks or other restraining devices required.

LLL. Furnish and install complete gas piping system. This contractor shall be required to connect to the utility companies' assembly at the main gas shut off valve outside the building that is provided by the utility company.

MMM. Furnish and install a complete compressed air piping system.

END OF APPENDIX D

SECTION 01 1320 – APPENDIX E

CONTRACT PACKAGE 16A – ELECTRICAL CONTRACT PACKAGE

This work shall include all labor, supervision, material, tools, equipment, shop drawings, submittals, layout, unloading, scaffolding, ladders, hoisting, transportation, taxes, permits, engineering, support functions, insurance, bonds, and any other items or services necessary for and reasonably incidental to the proper execution and completion of the work, whether temporary or permanent, in accordance with all drawings, specifications, addenda, general conditions, requirements, and other related documents as indicated herein and/or within Section 011300 – CONTRACT PACKAGE DOCUMENT REFERENCE and/or within the project contract and/or procurement documents.

1.1 Scope of Work:

A. Contractor shall be responsible for completing all Work indicated within the contract documents unless specifically indicated to be part of another contract package. See applicable specification sections and drawings: Refer to Section 011300 – Contract Package Document Reference
   1. Where work is indicated under more than one contract package, the Work shall be completed by one of the contractors and credit shall be provided by the other contractor. The Owner shall decide which contractor completes the work scope and which Contractor(s) will be required to provide a credit to the Owner.

B. Temporary Facilities: The contractor shall provide all temporary facilities required to complete the scope of work of this contract package that are not specifically provided for under another contract package scope.
   1. Contractor shall be responsible for providing temporary service to the General Use Job site trailer provided under 1A Contract. This Contractor will be required to coordinate with the utility company and pay for the set-up of the service. All temporary poles, underground and above ground wiring step down transformers, etc. as required to provide working power in the trailer will be by this contractor. Removal of service to this trailer will also be the responsibility of this Contractor at an agreed upon time by the Owner and Architect.

C. Each Contractor shall maintain appropriate facilities for their personnel with regards to environmental working conditions and as required by occupational safety regulations.

D. Contractor shall be responsible for complying with all permit conditions. Any fines associated with non-compliance with said permits and approvals shall be the responsibility of the Contractor.

E. Contractor shall maintain a set of as-built drawings and keep current. On a weekly basis the overall master as-built set kept within the 1A Contractors site trailer shall be updated to reflect the current as built conditions. Upon project closeout the individual and overall master as-built sets will be submitted to the Owner.

F. Contractor shall develop and maintain a project schedule. The initial schedule for each contractors work shall be provided to and coordinated with the 1A General Contractor. See Appendix A for additional information.
G. Progress Photos: Each Contractor must submit on a weekly basis and when requested by Owner or Architect daily progress photos of the work being performed. Additional photos of questioned items or in place construction or existing conditions may be requested by Architect at any time without additional cost to the contract. A line item will be required for this activity within the schedule of values and will not be approved for progress billing without Owner approval that this task was completed and acceptable.
H. Contractor shall provide layout/stakeout as required to perform work of this contract package. Control points shall be maintained throughout the duration of the project.
I. This Contractor shall perform all trenching and backfilling activities required to complete the work of this contract.
    1. Soil shall be striped and stockpiled temporarily. Contractor shall haul off site any excess. Soil amendments shall be documented by third party engineer and quantities surveyed by a professional surveyor. Truck counts or other indefinite methods of quantifying soil remediation will not be acceptable and payment will be withheld for the Work. Reports shall be submitted documenting both remediation technique and quantities. Quantity of amended soils and remediation shall be completed and payment for such activities shall be based upon established unit pricing and estimated contract amounts identified as separate line items within the approved schedule of values.
    2. Backfilling operations shall be sufficient to bring back to grade as shown on Civil Drawings. Base and fill shall be tested in accordance with the specifications; notify Owner and Architect of any corrective work required prior to commencing this work. Contractor is responsible for all soil excavation and remediation that can be reasonably inferred from the provided information with the Contract Documents and the Geotechnical Report(s). Unforeseen conditions requiring soil remediation shall be documented by third party engineer and quantities surveyed by a professional surveyor. Truck counts or other indefinite methods of quantifying soil remediation will not be acceptable and payment will be withheld for the Work. Reports shall be submitted documenting both remediation technique and quantities. Quantity of amended soils and remediation shall be completed and payment for such activities shall be based upon established unit pricing and estimated contract amounts identified as separate line items within the approved schedule of values.
    3. Protect stockpiled backfill material from becoming unsuitable for its intended use. If material becomes unsuitable take necessary measures to bring it to within specifications or remove it and import new material at no additional cost to the Owner.
J. Site Utilities and Structures: This Contractor is responsible for all electrical distribution including but not limited to incoming electrical service and branch

electrical runs to onsite items/equipment and data and communication distribution including but not limited to incoming/outgoing/campus cable service, phone service, and data service for this project. This contractor shall be responsible for providing electrical service to site work provided under other contract packages that requires power. All other site utilities including but not limited to water distribution, storm water, sanitary distribution, and gas distribution shall be under another contract package.

1. Provide all concrete work associated with utility work such as duct banks, etc. All utility trenching and backfilling for this work shall be inspected and tested by a third party testing agency.
2. Obtain all inspections required by AHJ.
3. Furnish project record documents accurately recording actual locations of electrical and data/communication systems and invert elevations and identify and describe unexpected variations in subsoil conditions and discovery of uncharted utilities.

K. Contractor shall be responsible for providing plenum rated materials or protective coverings acceptable to the authority having jurisdiction that provide non-plenum rated materials code compliant protection when installed within a plenum space.
L. Daily cleanup and removal of all trash and debris generated by the Work. Dumpsters will be provided by the 1A Contractor. Upon completion of each phase of work in any given area, the Contractor shall leave the area in a broom-clean condition.
M. Contractor shall clean adjacent streets and parking areas of tracked out materials.
N. Obtain all inspections required by AHJ.
O. Review equipment suppliers "recommended installation procedures" to assure that design complies with manufacturer's space clearances and clearances established by local authorities for maintenance and service.
P. Contractor shall be responsible for providing seismic design and required struts, bracing, and other accessories/structural components required to comply with seismic design requirements for all work included under the 15A contract package. Seismic design shall be a delegated design requirement of this contract.
Q. Contractor shall provide all concrete work or other cementitious work required by, shown or specifically referenced by detail on the electrical contract documents, including but not limited to all equipment pads, duct bank and housekeeping pads. Contractor shall provide all concrete additives, hardeners, curing compounds and other surface treatments. Contractor shall be responsible to provide all concrete hot water, ice, blankets, related protection, etc. necessary to complete work regardless of temperature.
R. Coordinate with all other Contractors pouring cast-in-place concrete to ensure all rough-ins, embeds, etc. are in place and properly located.
   1. Items include but are not limited to equipment, conduits, piping, wiring, devices, plates, etc.

2. Contractor shall provide to the 1A Contractor all sleeves, plates and other such embedded items that support or allow penetration through all cast-in-place concrete that are required to complete the work of this contract. This contractor shall be responsible for setting/placing continuously run work within and/or under cast-in-place concrete such as piping, conduit and similar such items.
3. Contractor shall produce coordination drawings indicating all embedded items. Coordination drawings shall be provided to All contractors for review and coordination of their work. All contractors shall be required to sign the completed coordination drawings prior to the placement of cast-in-place concrete. Each Contractor shall have a separate line item within the Schedule of Values for coordination drawings. This item will not be approved for progress billing without Owner approval that this task was completed and acceptable.

S. Testing and Inspections: This Contractor shall be responsible for all testing and inspections for the work of this contract package that is not specifically indicated to be a part of another Contract Package. The 1A, 15A and 15B contractors shall be responsible for the testing and inspections of their specific systems. Perform all testing and inspection services in accordance with the contract documents, local code requirements and applicable reference documents.
T. NOT USED
U. The 1A Contractor shall be responsible for all unit masonry, grout, and all related accessories and shall be responsible for placing all masonry embeds, anchor bolts, base plates, leveling plates, bearing plates, inserts, sleeves, clips, reglets, steel lintels, masonry reinforcing steel, and all other masonry embedded accessories as required to complete the project with the exception of continuously run piping and conduits. This Contractor shall be responsible for supplying all embeds to the 1A contractor.
    1. Contractor shall coordinate with all other trades regarding built-in or embedded items. Contractor shall coordinate and confirm with 1A contractor all masonry opening sizes that are required by this contract package. 1A Contractor shall close in all penetrations, pockets, and openings after embedded items are installed and inspected. Once close in is complete, it shall be the responsibility of this contractor to fire seal/safe, caulk or otherwise seal the Work of this contract package to the masonry.
V. Contractor shall provide all insulation, fire safing, fire stopping systems, and sound insulation associated with this work.
W. Contractor shall provide all miscellaneous metal items to support his work including but not limited to all hangers, rods, strut channel metal framing, and accessories including but not limited to seismic accessories. This Contractor shall supply the 1A contractor all items to be embedded within CMU, Cast-in-place concrete and Pre-cast Concrete that are required to support their work.
X. Contractor shall be responsible for providing all pour stops and miscellaneous angles or plates required to complete the work of this contract package whether shown on drawings or not. Miscellaneous steel may be indicated on any drawing.

Y. Contractor shall provide all carpentry work as required to complete the work of this Contract Package including but not limited to the following:
   1. Miscellaneous Rough Carpentry
   2. In wall wood blocking.
   3. All wood shall be fire/weather treated to comply with applicable codes and AHJ.

Z. Contractor shall provide all roofing accessories required by this contract package. 1A Contractor shall tie roofing assembly into items provided by this contractor.

AA. This contractor shall coordinate with other contractor's locations of new work that may need to be temporarily left out to facilitate the mobilization or installation of large equipment in order to complete the work of this contract.

BB. Contractor shall furnish to the 1A contractor all access doors/panels required for the completion of this work. Contractor shall provide coordination drawings to the 1A contractor indicating placement of all access doors/panels. 1A contractor shall be responsible for installing all access doors/panels. Contractor shall coordinate access panels with building finishes and assemblies for proper type of panel/installation. Coordination drawings shall be required to be approved by the Architect prior to installation of ANY portions of systems. Placement of work to be accessible shall be placed such that access doors/panels shall be set in an inconspicuous location.

CC. Furnish and install all caulking, joint sealants, and firestopping for this contract. Other Contractors shall be responsible for providing caulking, joint sealants and firestopping for their contract scope. Where caulking, joint sealants and firestopping are required between work of different contractors, the contractor installing work onto, into or through another contractors work shall be responsible for providing the required caulking, sealant or firestopping.

DD. Contractor must coordinate solid fill for equipment attachments with the Masonry Contractor.

EE. Contractor shall furnish and install all supports, bracing, clips, wood plates, anchors bolts, grounds, angles, strut channel framing and other support items required to complete the installation of work included within this contract package including but not limited to vibration isolation accessories and seismic bracing and other seismic accessories. Contractor shall be required to provide any miscellaneous or structural steel required but not detailed on the structural drawings to support work under this contract package.

FF. The contractor shall coordinate rough-in power requirements for all items included in this contract package and all other contract packages. All control wiring, integral wiring, and final connection to power source junction box(es) for the work of this Contract Package shall be executed by this Contractor. Any wiring required within any unit (between multiple internal fixtures etc.) will be the responsibility of this contractor.

GG. Cutting, patching, core drilling, sleeves and penetrations required.

HH. All escutcheons as required to complete the work.

II. Identification devices (label and tags.)

JJ. Permitting and fees other than grading and building permit.

KK. Demonstrations of all systems associated with this work shall be videotaped and turned over to the Owner. Recording to be on DVD with sign-in sheets also provided.

LL. Touch-up all damages to factory applied finishes.

MM. All major equipment must be located in accordance with the drawings and all code requirements.

NN. Return for maintenance during Guarantee/Warranty period as specified.

OO. Coordinate location of all materials/equipment above ceilings with other trades. Any conflicts must be resolved prior to the start of work. All equipment must be located in accordance with the drawings and all code requirements.

PP. This Contractor to provide all lintels for their work.

QQ. With regard to equipment to be provided by this contract package this contractor is responsible for all costs incurred by modifications due to discrepancies between approved equipment and basis of design equipment as shown on bid documents. Modifications include but are not limited to service modifications (electrical, plumbing, fire protection, etc.), structural modifications, and architectural modifications. All equipment power requirements to be reviewed by this contractor. A list of equipment requiring deviations from the contract documents shall be submitted within ten (10) days after approved submittals are returned to the contractor.

RR. All insulation required by the specifications drawings and governing codes for work of this contract package.

SS. Provide duct smoke detectors to 15A Contractor for installation. This (16A) contractor shall be required to provide all power/low voltage/data/communication wiring required for proper and complete operation.

TT. All equipment to be provided to the owner per the contract documents, including but not limited to computers, software, printers, software licenses, etc.

UU. Contractor shall be responsible to receive, unload and store in weatherproof secure trailers and in a manner and location acceptable to Owner all items to be incorporated into the project.

VV. Review structural documents and coordinate pier and foundation elevations with 1A contractor so they do not interfere with under slab work.

WW. Job is bid as unclassified for all soil/rock conditions. Reference the geotechnical engineer report(s). Contractor is responsible for all subsurface conditions and costs associated with completing the work. Contractor shall haul and dispose offsite all excess soils and import suitable soils where required to complete the work.

XX. Contractor shall confirm and accept the subgrade elevation prior to beginning underground work. Commencement of underground work shall constitute acceptance of subgrade in the general area of the work. Contractor shall restore compacted subgrade to design elevation, including but not limited to removal of all earthwork spoils, immediately upon completion of underground work in any and all areas. Unsuitable material will be replaced with approved structural fill at no additional cost.

YY. Provide labor, standby mechanics and equipment for all testing and startup (fire alarm, smoke control, etc.)
ZZ. All support members required for hanging raceways, conduits, lights, panels, disconnects, etc. This includes in-wall blocking required to support any electrical equipment.
AAA. Identification labels.
BBB. Below and above slab conduit and wiring.
CCC. Electrical resistance heating systems.
DDD. Electrical equipment pads below equipment by this contractor, interior and exterior, including concrete, reinforcement, placement, lay-out, etc.
EEE. The contractor shall contact, coordinate with and provide all necessary information to the appropriate utility companies. Any costs incurred from public utility companies in order to provide indicated systems and carry out intent of the drawings will be the responsibility of this contractor.
FFF. Pipe hangers, anchors, steel supports, all-thread, sealing, guides.
GGG. Provide dimensioned plan for all floor mounted boxes.
HHH. Lighting and Power Systems:
1. Metering and electrical distribution system to panel boards.
2. All electrical site work shown on the bid documents including, but not limited to, primary feeders, secondary feeders/ductbank, IT/DATA/Communications conduits (including incoming service), concrete encasement where shown and under all paved areas, trenching and backfill, utility transformer pad, generator ductbank, site lighting systems.
3. Complete wiring system for power, lighting, receptacles, and special systems.
4. Install, maintain and remove temporary power and lighting for building. Temporary lighting to be installed in accordance with anticipated partition layout to provide per OSHA requirements, but not less than 3 foot candles at any location in the building. All temporary power to be in accordance with OSHA requirements (ground fault) and to be placed so that no extension cord greater than 100 ft. will be required. LED lamps to be used for all temporary lighting strings. Contractor should maintain bulbs and expand transitions to permanent lighting with lamp maintenance until substantial completion. Temporary service to be 3 phase fed from permanent transformer with step down transformer to single phase 400 amp exterior grade temporary panel. Provide temporary pole or other means of panel support. Provide (2) exterior grade, quad outlets on the pole at the temp panel. Note: to achieve 400 amp temporary service, METED may require additional panels, meters, etc. which are to be included in the 16A Contractor's base bid.
5. Rough-in/hookup for equipment and fixtures furnished and installed by others.
6. Installation of equipment and fixtures furnished by other contractors.
7. Fire-rated termination boards.
8. Equipment connections for electrical equipment.
9. Equipment connections for HVAC
10. Provide power and make connections of motor operated dampers installed by others.
11. Emergency and exit lighting

12. Interior and exterior fixtures including site lighting and pole bases.
13. Panels, switches, receptacles, pull boxes, conduit, wiring, etc.
14. Grounding system and lighting protection system.
15. Aiming/spotting of directional lighting as instructed by Architect.
16. Cabinets, panelboards and switchboards.
17. Motor control centers.
18. Contractor shall provide power for appliances and equipment provided by other contractors and the Owner. Contractor shall coordinate with appliance/equipment furnished, to ensure that proper rough-ins and receptacles are provided under this contract. Review all documents for locations of smoke detectors, fire/smoke dampers, etc. Conflicts should be brought to the attention of the Architect during the rough-in phase, otherwise it will be moved at this contractor's expense. Final connections will be made by this contractor.
19. General use projectors, televisions, and electronic displays will not be included in this contract. This contractor will be responsible for providing all conduit, cabling, wiring, outlets, data ports, etc. indicated within contract documents to accommodate this equipment. General use projectors, televisions, and electronic displays will be furnished by the Owner. This contractor will accept delivery, unload, unpack, install, test, focus, and adjust equipment to ensure proper function. This contractor is responsible for conducting a survey of equipment as it is received. Any unacceptable equipment is to be brought to the attention of the Owner/Architect immediately. This contractor will be responsible for the correct operation of all equipment not presented as unacceptable at time of survey.
20. Starters will be by this contractor unless specifically indicated to be provided under another contract package. This contractor shall coordinate with mechanical and plumbing contractor regarding motor starters for mechanical and plumbing equipment. Electrical contractor shall furnish all motor starters, contactors, safety switches, disconnect switches, and controls not specifically assigned to be provided by other contractors.
21. Furnish and install all heat tape required by contract documents.
22. All site lighting, conduit, fixtures, pole bases, excavation, concrete, reinforcement, etc. as needed to provide a complete system.

III. Fire Alarm System:
1. Provide complete fire alarm system.
2. Coordinate with HVAC for installation of duct smoke detectors and dampers (supplied by this contractor, installed by the 15A contractor.)

JJJ. All low voltage systems, accessories, hardware equipment, adjustments, testing, programming, etc. to furnish and install complete system as indicated in the contract documents.
1. Complete data system as indicated within contract documents.
2. Access control system shall be equipment, hardware, wiring, software, etc. shall be provided and installed by the Owner. 16A Contractor shall provide power to junction box and junction box for final connection by Owner and conduit and pull string to equipment.

3. Security Cameras shall be provided by Owner and installed by this contractor. This contractor shall provide all conduit, data wiring, control wiring, power, junction boxes and terminations.
4. Raceways for telephone system, including pulling of wires, installation and connection jacks by this contractor.
5. Telephone, CATV, and other data conduits with pull strings. All wire to be included where indicated within the documents.
6. Protection of fire/smoke devices from construction dust. Replacement will be by this contractor if required prior to turnover of the building regardless of cause of damage.
7. All cable tray to be by this contractor.
8. All cabling, displays, selector switches, control devices, strobes, lightings, speakers, wiring, server, and all other devices associated with the Computer Aided Dispatch (CAD) Alerting System are by this contractor.

KKK. This Contractor shall be responsible for performing the work within the existing Administration Building and Community Recreation Center. Contractor shall perform selective demolition in areas that require cutting and patching. Contractor shall remove existing ceiling finishes and replace them to match condition at time of project bidding. Contractor shall protect all existing surfaces for the duration of the work and shall maintain clear egress and circulation pathways throughout existing spaces. Coordinate work with occupants and do not proceed until receiving written permission from the Owner.

END OF APPENDIX E

SECTION 01 2100 - ALLOWANCES

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 governing allowances.

B. Types of allowances include the following:

1. Contingency allowances.

C. Related Requirements:

1. Section 01 2200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
2. Section 01 2600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
3. Section 01 4000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1. Contingency Allowances shall be utilized by the Owner at their sole discretion. Contingency allowances are not for the Contractor's use.

1.4 SELECTION AND PURCHASE

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

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

1.5 ACTION SUBMITTALS

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

1.6 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.

1.7 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, insurance and related costs associated with the contingency allowance shall be included within the Base Bid. The contingency allowance shall be utilized for products, equipment, material, labor and similar costs.

C. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 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, required maintenance materials, 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.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs due to a change in the 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.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

A. General Contract Package Allowance Schedule

1. GC Allowance No. GC1: Contingency Allowance: Include a contingency allowance of $125,000.00 for use according to Owner's written instructions.
2. GC Allowance No. GC2: Contingency Allowance: Include a contingency allowance of $50,000.00 for use according to Owner's written instructions.
3. GC Allowance No. GC3: Contingency Allowance: Include a contingency allowance of $25,000.00 for use according to Owner's written instructions.

B. Plumbing Contract Package Allowance Schedule

1. PC Allowance No. PC1: Contingency Allowance: Include a contingency allowance of $40,000.00 for use according to Owner's written instructions.

C. Mechanical Contract Package Allowance Schedule

1. MC Allowance No. MC1: Contingency Allowance: Include a contingency allowance of $60,000.00 for use according to Owner's written instructions.

D. Electrical Contract Package Allowance Schedule

1. EC Allowance No. EC1: Contingency Allowance: Include a contingency allowance of $75,000.00 for use according to Owner's written instructions.

END OF SECTION 01 2100

SECTION 01 2200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:

1. Section 01 2600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 01 4000 "Quality Requirements" for general testing and inspecting requirements.

1.2 DEFINITIONS

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

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit-Price No. 1: Removal of Unsatisfactory Soil

1. Description: Unsatisfactory soil excavation and disposal off site, as required, according to Section 31 2000 "Earth Moving".
2. Unit of Measurement: One Cubic Yard of soil excavated, based on survey of volume removed.

    a. Measurement or quantification of soil by truck load or volume of expanded soil will not be acceptable.

B. Unit-Price No. 2: Rock Removal

1. Description: Classified rock excavation and disposal off site, as required according to Section 31 2000 "Earth Moving".
2. Unit of Measurement: One Cubic Yard of rock excavated, based upon survey of volume removed.

    a. Measurement or quantification of soil by truck load or volume of expanded soil will not be acceptable.

C. Unit-Price No. 3: Soil Moisture Reduction - Quicklime.

1. Description: Remove excessive moisture from suitable soil subgrade through the application and mixing of quicklime into subgrade lifts (agricultural lime is an unacceptable substitute.)

    a. Engage a Geotechnical Engineer to determine appropriate quantity of quicklime to apply per square yard of wetted subgrade to a depth of 12 inches, based upon moisture content and type of subgrade, to ensure that all applied quicklime will chemically react with present soil moisture, and no unreacted quicklime will remain dormant in subgrade at the conclusion of soil drying process.
    b. Furnish and apply granular quicklime in a uniform broadcast to each in situ subgrade lift with above-optimum moisture content.
    c. Uniformly mix and distribute quicklime through subgrade to a depth of 12 inches. Use specialized lime spreading equipment for large-scale application and mixing, or agricultural or earthmoving equipment for small-scale application and mixing.
    d. Allow quicklime to react with soil moisture for 24 to 48 hours, then re-mix until no visible lime particles remain.

e. If visible lime particles remain, repeat reaction period and re-mixing process until no lime particles are present.
f. Develop and provide adequate dust-control measures to prevent blowing or spreading of alkaline dust outside of the confines of the direct application area, and determine and provide appropriate personal protective equipment to personnel.

2. Unit of Measurement: One percent of quicklime by dry weight of soil, applied per square yard and mixed to one foot depth (1% Dry Wt. / Sq. Yd at 1 ft. depth).
3. Quantity applied shall be substantiated by on-site third party geotechnical engineer.

D. Unit-Price No. 4: PennDOT 2A Fill

1. Description: Upon completion of unsatisfactory soil removal and new subgrade compaction, provide and install, in 8 inch lifts, PennDOT 2A fill with maximum aggregate size of 1.5 inches and no more than 2% passing #200 sieve, as required, according to Section 31 2000 "Earth Moving"
2. Unit of Measurement: One cubic yard.
3. Quantity shall be determined by professional surveyor of quantity of in-place unsatisfactory soil to be replaced.

E. Unit-Price No. 5: #57 Stone Fill

1. Description: Upon completion of unsatisfactory soil removal and new subgrade compaction, provide and install #57 (AASHTO #57) stone fill, as required, according to Section 31 2000 "Earth Moving."
2. Unit of Measurement: One cubic yard.
3. Quantity shall be determined by professional surveyor of in-place unsatisfactory soil to be replaced.

F. Unit-Price No. 6: Granular natural soil fill.

1. Description: Upon completion of unsatisfactory soil removal and new subgrade compaction, provide and install natural granular fill soil, as necessary, according to Section 31 2000 "Earth Moving."
2. Unit of Measurement: One Cubic Yard.
3. Quantity shall be determined by professional surveyor of in place unsatisfactory soil to be replaced.

END OF SECTION 01 2200

SECTION 01 2300 - ALTERNATES

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 alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 01: Omit Lobby and Meeting Room Casework.

1. Base Bid: In Lobby 101 and Meeting Room 104, provide all casework as indicated in the Drawings.
2. Alternate: In Lobby 101 omit two (2) wall-recessed casework units, and in Meeting Room 104 omit one (1) wall-recessed casework unit; in lieu, finish gypsum wall board alcoves to Level 4 and prime and paint; install wall base as scheduled for each room; and extend floor coverings into alcove as scheduled for each room.

B. Alternate No. 02: Omit Resinous Flooring Integral Base.

1. Base Bid: Provide Resinous Flooring integral cove base at all resinous flooring areas indicated in the Finish Schedule.
2. Alternate: Remove resinous flooring integral cove base; in lieu, provide wall surface finished to floor, primed and painted.

C. Alternate No. 03: Sealed Concrete In Lieu of Resinous Flooring.

1. Base Bid: Provide Resinous Flooring and integral base, including reflective striping, as indicated in the Finish Schedule.
2. Alternate: Remove Resinous Flooring and associated integral base in its entirety from all areas indicated in the Finish Schedule; in lieu, provide sealed concrete floor finish.

D. Alternate No. 04: Sectional Doors In Lieu of Four-Fold Doors.

1. Base Bid: Provide Four-Fold Doors FFB1-5F and FFB1-5R as indicated in the Drawings and as specified in Section 08 3513, "Bifold Doors".
2. Alternate: In lieu of Four-Fold Doors, provide for openings FFB1-5F and FFB1-5R fully-glazed sectional doors and controls; basis-of-design: Raynor; AlumaView AV300, as follows:

    a. ½-inch thickness clear, fully tempered insulating glazing units.
    b. 3 inch heavy duty tracks and rollers
    c. Heavy duty springs, minimum lift cycle of 90,000 operations.
    d. Jack-shaft-mounted motor.
    e. Two (2) push-button remote operators for each door.
    f. Safety door edge and photoelectric eye sensor safety system.
    g. 1 manual pushbutton station at interior jamb of each door.

h. Include General Contractor coordination of re-design for door weight, attachment locations, and motor power requirements.

E. Alternate No. 05: Omit Steel Beam for Future Operable Partition.

1. Base Bid: In Meeting Room 104, provide and install structural steel beam and supporting steel columns for future operable partition, located between Column Lines (E) and (F), as indicated in the Drawings.
2. Alternate: In Meeting Room 104, remove from the Scope of Work the structural steel beam and two (2) supporting steel columns for future operable partition, located between Column Lines (E) and (F). Column footings and baseplate shall remain in the Contract, and shall not be omitted.

F. Alternate No. 06: Painted Gypsum Wall Board In Lieu of Wall Tile, Restrooms.

1. Base Bid: In Rooms 102, 103, 115, 116, 120, and 121, provide wall tile on backer board and associated setting materials and accessories as indicated in the Finish Schedule and as specified in Specifications Section 09 3013, "Ceramic Tiling".
2. Alternate: In Rooms 102, 103, 115, 116, 120, and 121, omit wall tile on all walls EXCEPT for walls against which toilets and urinals are installed; in lieu, provide level-4-finish gypsum wall board, primed and two-coat painted with satin latex paint system indicated in Section 09 9123, "Interior Painting". Do not omit wall tile for walls in those rooms against which urinals and toilets are indicated to be installed.

G. Alternate No. 07: Add MVE-Control System to Interior Concrete Slabs On Grade to Mitigate High Slab Moisture Problems.

1. Base Bid: Omit Moisture-Vapor-Emission Control system as specified in Section 09 0561.13, "Moisture Vapor Emission Control" in its entirety from the Scope of Work.
2. Alternate: Furnish and install the Moisture-Vapor-Emission Control system, including all components, labor, and accessories, as specified in Section 09 0561.13, "Moisture Vapor Emission Control" to all interior concrete slabs-on-grade, except in locations and under specific types of floor coverings specifically indicated in Section 09 0561.13.

H. Alternate No. 08: Solid Exterior Wall In Lieu of Rear Apparatus Bay Door FFB1-5R.

1. Base Bid: Provide four-fold door FFB1-5R in the rear wall of the Apparatus Bay, as indicated in the Drawings.
2. Alternate: Delete four-fold door FFB1-5R and associated controls and accessories from the Scope of Work; and in lieu of door and opening, provide an equal square-foot area of exterior wall construction (Wall Types E1 and E2) in place of door, for a seamless, uninterrupted expanse of exterior wall. The structural steel and lintel associated with the omitted Door FFB1-5R shall remain in the Scope of Work.

I. Alternate No. 09: Lawn in Lieu of Rear Apron.

1. Base Bid: Provide the concrete slab-on-grade apron to the plan-north side of the Apparatus Bay from the face of the building to the existing roadway, and associated subgrade and site grading as indicated in the Drawings.
2. Alternate: Remove from the Work the rear concrete apron and associated subgrade and site grading, from plan-north face of the Apparatus Bay to the connection to the existing roadway; and remove bollards along plan-north exterior face of the building. In lieu, extend sidewalk along plan-north exterior wall of Apparatus Bay, from the plan-northeast-corner of the building to the concrete utility pad location in the middle of the plan-north exterior wall; and lawn consisting of suitable fill and 4 inches of topsoil finish-graded to contour of adjoining lawn and roadway, grass seed, and straw thatch.

J. Alternate No. 10: Reduce Standing Seam Roof Thickness.

1. Base Bid: For Roof Types R-1 and R-2, provide standing seam metal roof of gage as indicated in Specifications Section 07 4113.16, "Standing Seam Metal Roof Panels".
2. Alternate: For Roof Types R-1 and R-2, in lieu of specified thickness, reduce metal thickness of standing seam metal roof panels to 0.025 inch (24 gage).

END OF SECTION 01 2300

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 01 2100 "Allowances" for products selected under an allowance.
2. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 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.
3. Compatibility: Compatibility shall be determined by the Architect and Owner at the time of the substitution request. Products shall not be considered compatible if the products require the Owner to purchase or maintain attic stock, maintenance stock or replacement parts of two different products that perform the same function.

1.4 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. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. Certificates and qualification data, where applicable or requested.
    g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
    j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
    k. Cost information, including a proposal of change, if any, in the Contract Sum.
    l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
    m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 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.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. 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: Not allowed unless otherwise indicated.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

SUBSTITUTION REQUEST FORM

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section Number: _____

Page Number: _____ Article: _____

Proposed Substitution: _____

Manufacturer: _____ Website URL: _____

Trade Name: _____ Model No.: _____

Installer: _____ Phone: _____

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached (Note: This is REQUIRED for consideration as a proposed Substitution)

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

Does proposed substitution affect other Work? ☐ No ☐ Yes (explain) _____

Cost Savings: [Deduct] _____ Dollars $ _____

Schedule Impact: [Add] [Deduct] _____ days.

THE UNDERSIGNED CERTIFIES:

- Proposed substitution has been fully investigated by the General Contractor, and determined to be equal or superior in all respects to specified product.
- General Contractor acknowledges that this proposed substitution must also meet the design intent expressed in the Contract Documents, as judged by the Architect and substantiated by the materials submitted herewith.
- General Contractor will furnish the same warranty for proposed substitution as for specified product.
- General Contractor has verified that the same level of maintenance service and similar availability of replacement parts, as applicable, is available.
- General Contractor has verified that the proposed substitution will have no adverse effect on other trades, and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent will be waived by the General Contractor.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made by the General Contractor for changes to building design, including A/E design, detailing, and construction costs caused by this substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be completed by the General Contractor in all respects.

Submitted By (Name): _____

Signature: _____

On Behalf of (Company): _____

Address: _____

Email: _____

Attachments: _____

_____

_____

ARCHITECT'S REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 3300.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 3300.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Architect: Manns Woodward Studios, Inc.

Reviewed By (Name): _____

Signature: _____

Date: _____

END OF SUBSTITUTION REQUEST FORM

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within 14 consecutive days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.4 CHANGE ORDER PROCEDURES

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

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 01 2200 "Unit Prices" for administrative requirements governing the use of unit prices.
2. Section 01 2600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Section 01 3200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.
c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Sub-schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub-schedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section. Owner reserves the right to require line items of the schedule of values be broken down further as may be required to satisfy the Owner.

1. Identification: Include the following Project identification on the schedule of values:

   a. Project name and location.
   b. Prime Contractor's Name.
   c. Name of Architect.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

5. 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.
6. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Submit Application for Payment to Architect. The period covered by each Application for Payment is one month, ending on the last day of the month.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

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. Submittal schedule (preliminary if not final).
5. Certificates of insurance and insurance policies.
6. Performance and payment bonds.
7. 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.

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. Updated final statement, accounting for final changes to the Contract Sum.
3. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
4. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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. Requests for Information (RFIs).
4. Project meetings.

B. Each contractor (each Prime Contractor and each Sub-contractor) shall participate in coordination requirements. The contract documents do not specify that certain areas of responsibility are assigned to a specific contractor, therefore it is the General Contractor's responsibility to include all sub-contractors within the coordination process.

C. Related Requirements:

1. Section 01 3200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 7700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 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, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 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.

a. Coordinate construction sequence with Work to be completed by other Prime Contractors, where applicable and necessary for installation per the requirements of the Contract Documents.

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. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner, and separate Prime Contractors and Sub-contractors if coordination of their Work is required.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Indicate Work to be completed, and identify related work to be completed by other Prime Contractors.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.7 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Architect.
5. RFI number, numbered sequentially.
6. RFI subject.
7. Specification Section number and title and related paragraphs, as appropriate.
8. Drawing number and detail references, as appropriate.
9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
11. Contractor's signature.
12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.

d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. 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.
3. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Lines of communications.
    f. Procedures for processing field decisions and Change Orders.
    g. Procedures for RFIs.
    h. Procedures for processing Applications for Payment.
    i. Distribution of the Contract Documents.
    j. Submittal procedures.
    k. Preparation of record documents.
    l. Use of the premises and existing building.
    m. Work restrictions.
    n. Working hours.
    o. Owner's occupancy requirements.
    p. Responsibility for temporary facilities and controls.
    q. Procedures for disruptions and shutdowns.
    r. Parking availability.
    s. Office, work, and storage areas.
    t. Equipment deliveries and priorities.
    u. Security.
    v. Progress cleaning.

4. Minutes: The Architect will be responsible for recording and distributing the meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. Contract Documents.
    b. Related RFIs.
    c. Related Change Orders.

d. Submittals.
e. Review of mockups.
f. Possible conflicts.
g. Compatibility requirements.
h. Time schedules.
i. Weather limitations.
j. Manufacturer's written instructions.
k. Warranty requirements.
l. Compatibility of materials.
m. Acceptability of substrates.
n. Coordination with other work.
o. Protection of adjacent work.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
6. Minutes: The Architect shall record and distribute the meeting minutes.

D. Progress Meetings: Conduct progress meetings at biweekly intervals. The Owner reserves the right to change the frequency of the progress meetings.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.

3) Status of submittals.
4) Access.
5) Site utilization.
6) Progress cleaning.
7) Status of correction of deficient items.
8) Field observations.
9) Status of RFIs.
10) Status of proposal requests.
11) Pending changes.
12) Status of Change Orders.
13) Pending claims and disputes.
14) Documentation of information for payment requests.

4. Minutes: The Architect shall record and distribute the meeting minutes to each party present and to parties requiring information.

   a. Schedule Updating: General Contractor shall 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 01 3100

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.

B. Related Requirements:

1. Section 01 3300 "Submittal Procedures" for submitting schedules and reports.
2. Section 01 4000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. PDF electronic file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

C. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

E. Daily Construction Reports: Submit at monthly intervals.

F. Stored Material Location Reports: Submit at monthly intervals.

G. Site Condition Reports (Daily Log): Submit at time of discovery of differing conditions.

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Discuss constraints, including phasing work stages area separations interim milestones and partial Owner occupancy.
2. Review delivery dates for Owner-furnished products.
3. Review submittal requirements and procedures.
4. Review and finalize list of construction activities to be included in schedule.
5. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

a. The Contractor shall be responsible for providing the required items, materials, procedures, and protections to complete the Work within the Time Frame set forth within the Contract Documents. This includes, but is not limited to, items required to work within the weather conditions reasonably expected within the Contract Time Frame.

B. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Use of premises restrictions.
    c. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Submittals.
    b. Purchases.
    c. Mockups.
    d. Fabrication.
    e. Deliveries.
    f. Installation.
    g. Tests and inspections.
    h. Adjusting.
    i. Curing.
    j. Startup and placement into final use and operation.

3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.
    f. Substantial Completion.

C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including presence of rain or snow.
6. Accidents.
7. Unusual events (see special reports).
8. Stoppages, delays, shortages, and losses.
9. Change Orders received and implemented.
10. Construction Change Directives received and implemented.
11. Services connected and disconnected.
12. Equipment or system tests and startups.
13. Partial completions and occupancies.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 3200

SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Concealed Work photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.

B. Related Requirements:

1. Section 01 7700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 INFORMATIONAL SUBMITTALS

A. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based Project management software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Contractor.
d. Date photograph was taken.
e. Description of location, vantage point, and direction.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

C. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

D. Final Completion Construction Photographs: Take 100 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

E. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

a. Special events planned at Project site.
b. Immediate follow-up when on-site events result in construction damage or losses.
c. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.
f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3233

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Section 01 2900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 3200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 01 3300a "Submittal Review and Transmittal Form" for example of form the Architect will use for this project to record submittal review comments, and the actions required of the General Contractor in response to review comments.
4. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
5. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
6. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
4. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.
b. Specification Section number and title.
c. Submittal category: Action; informational.
d. Name of subcontractor.
e. Scheduled date for Architect's final release or approval.
f. Scheduled dates for purchasing.
g. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

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.

4. All items requiring color selections will not be reviewed for color selection until all related items requiring color selection are submitted respectively. Furthermore, no colors shall be chosen until the Owner has selected a color scheme based upon the submitted samples of finishes. For example, no exterior colors shall be selected until all items exposed on the exterior requiring a color selection have been submitted, grouped and selected by the Owner.
5. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. 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. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with the submittal number as follows.

    a. Contract Package# - Specification Section number.revision# - Short Description Generic example:

        1) ## - 05 7300.01 - Bracket Product Data•

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Architect.

d. Name of Prime Contractor.
e. Name of firm or entity that prepared submittal.
f. Names of subcontractor, manufacturer, and supplier.
g. Category and type of submittal.
h. Submittal purpose and description.
i. Specification Section number and title.
j. Specification paragraph number or drawing designation and generic name for each of multiple items.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Related physical samples submitted directly.
n. Indication of full or partial submittal.
o. Transmittal number, numbered consecutively.
p. Submittal and transmittal distribution record.
q. Other necessary identification.
r. Remarks.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. 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.

I. 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.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

    a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.
    e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
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.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

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 two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

a. PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 3200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 2900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."

L. 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.

M. 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.

N. 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.

O. 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.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. 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.

S. 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.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.

6. Test procedures and results.
7. Limitations of use.

U. 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.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. 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.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 7700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it.

1. Architect will affix a Submittal Review and Transmittal Form and will mark stamp appropriately to indicate action.

a. Refer to the sample Submittal Review and Transmittal Form, included as Section 01 3300a, directly following this Section, for example of the Form and the desicriptions of the possible review markings and General Contractor's required actions.

2. Architects review is only for the general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the Shop Drawings during this review do not relieve the Contractor from complying with the requirements of the Contract Documents or any AHJ (Authority Having Jurisdiction.) Review of a specific item shall not be deemed a review of the assembly of which the item is a component. The Contractor is responsible for (1) confirmation and correlation of all quantities and dimensions at the job site, (2) information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences, and procedures of construction, (3) the coordination of work with all other trades (4) for performing all work in a safe and satisfactory manner and (5) coordinating substrates and attachments to substrates/ supporting materials.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 3300

MANNS WOODWARD STUDIOS INC.

SUBMITTAL REVIEW FORM AND TRANSMITTAL

V21.3

Project:	Owner:

General/Prime Contractor:	Architect:	
	Manns Woodward Studios Inc. 10839 Philadelphia Road, Suite D White Marsh, Maryland 21162	Project Number:

SUBMITTAL

Name: 00 0000.001.001 Test Submittal Name

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. The purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

ARCHITECTS ACTION

By:

Date:

The following indicated "ACTION" is the appropriate deemed "ACTION" for the above indicated "SUBMITTAL". The "ACTION" indicated below is based upon a review of the Contractors "SUBMITTAL" but is only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Review of such "SUBMITTAL" is not conducted for the purpose of determining the accuracy and completeness of the other details such as dimensions and quantities, or for substantiating instructions for installation; All of which remains the responsibility of the Contractor. The Contractor shall not be relieved of responsibility for deviating from requirements of the Contract Documents by the Architects "Approval" of Shop Drawings. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar Submittals by the Architects "Approval" thereof.

☐ APPROVED:	Submittal conforms with information given and the design concept expressed in the Contract Documents
☐ APPROVED, COMMENTS NOTED:	Submittal conforms with information given and the design concept expressed in the Contract Documents EXCEPT AS NOTED. Contractor shall coordinate and/or adjust submittal information/Contractors work plan to conform to the information given and the design concept expressed in the Contract Documents. DO NOT RESUBMIT unless noted otherwise.
☐ REVISE AND RESUBMIT:	Submittal does not conform with information given and the design concept expressed in the Contract Documents. Contractor shall coordinate and/or adjust submittal information/Contractors work plan to conform to the information given and the design concept expressed in the Contract Documents. RESUBMIT.
☐ REJECTED	
☐ RETURNED WITHOUT ACTION	☐ Contractor did not review and "APPROVE" submittal. ☐ Other:

Comments

1. See ARCHITECTS ACTIONS.
2. Contractor shall coordinate submittal information and schedule of the Work with all trades.
3. Dimensional and quantity mark-ups are intended to convey conformance with design concept expressed in the Contract Documents. Contractor remains responsible for given information provided within the Contract Documents and the coordination of all quantities and dimensions with the Work and the existing conditions.
4. See following page(s) for additional comments.

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

C. 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.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

I. Experienced: When used with an entity or individual, "experienced" 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.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Highest Quantity or Quality Levels: The higher quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the higher 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 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

D. 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.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.7 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, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. General: 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.

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, 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. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

G. 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.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens, assemblies, 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, 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.

J. 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 in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

K. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.9 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not. Contractor shall have prior experience within jurisdiction Work is to be performed and shall therefore have knowledge of jurisdictions quality control services required. Quality control services required by the AHJ shall be included within contract and shall not be considered for additional services or Change to the Contract.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."

C. 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.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

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

END OF SECTION 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "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.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale'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: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is 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; www.aamanet.org.
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; (Formerly: ACI International); www.abma.com.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.

14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.

52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
73. ECIA - Electronic Components Industry Association; www.eciaonline.org.
74. EIA - Electronic Industries Alliance; (See TIA).
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
83. FM Approvals - FM Approvals LLC; www.fmglobal.com.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
85. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
86. FSA - Fluid Sealing Association; www.fluidsealing.com.
87. FSC - Forest Stewardship Council U.S.; www.fscus.org.
88. GA - Gypsum Association; www.gypsum.org.
89. GANA - Glass Association of North America; www.glasswebsite.com.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.

92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
94. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
95. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
96. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
100. ICC - International Code Council; www.iccsafe.org.
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
104. IEC - International Electrotechnical Commission; http://www.iec.ch.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
109. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
110. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
111. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
116. ISO - International Organization for Standardization; www.iso.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
119. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
120. LMA - Laminating Materials Association; (See CPA).
121. LPI - Lightning Protection Institute; www.lightning.org.
122. MBMA - Metal Building Manufacturers Association; www.mbma.com.
123. MCA - Metal Construction Association; www.metalconstruction.org.
124. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
125. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
126. MHIA - Material Handling Industry of America; www.mhia.org.
127. MIA - Marble Institute of America; www.marble-institute.com.
128. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
129. MPI - Master Painters Institute; www.paintinfo.com.

130. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
131. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
133. NADCA - National Air Duct Cleaners Association; www.nadca.com.
134. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
135. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
136. NBI - New Buildings Institute; www.newbuildings.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
138. NCMA - National Concrete Masonry Association; www.ncma.org.
139. NEBB - National Environmental Balancing Bureau; www.nebb.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
141. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
142. NEMA - National Electrical Manufacturers Association; www.nema.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
145. NFPA - National Fire Protection Association; www.nfpa.org.
146. NFPA - NFPA International; (See NFPA).
147. NFRC - National Fenestration Rating Council; www.nfrc.org.
148. NHLA - National Hardwood Lumber Association; www.nhla.com.
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
151. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
152. NRCA - National Roofing Contractors Association; www.nrca.net.
153. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
154. NSF - NSF International; www.nsf.org.
155. NSPE - National Society of Professional Engineers; www.nspe.org.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
157. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
158. NWFA - National Wood Flooring Association; www.nwfa.org.
159. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
160. PDI - Plumbing & Drainage Institute; www.pdionline.org.
161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
162. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
163. RFCI - Resilient Floor Covering Institute; www.rfci.com.
164. RIS - Redwood Inspection Service; www.redwoodinspection.com.
165. SAE - SAE International; www.sae.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
167. SDI - Steel Deck Institute; www.sdi.org.
168. SDI - Steel Door Institute; www.steeldoor.org.

169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
171. SIA - Security Industry Association; www.siaonline.org.
172. SJI - Steel Joist Institute; www.steeljoist.org.
173. SMA - Screen Manufacturers Association; www.smainfo.org.
174. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
177. SPIB - Southern Pine Inspection Bureau; www.spib.org.
178. SPRI - Single Ply Roofing Industry; www.spri.org.
179. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
180. SSINA - Specialty Steel Industry of North America; www.ssina.com.
181. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
182. STI - Steel Tank Institute; www.steeltank.com.
183. SWI - Steel Window Institute; www.steelwindows.com.
184. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
186. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
187. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
190. TMS - The Masonry Society; www.masonrysociety.org.
191. TPI - Truss Plate Institute; www.tpinst.org.
192. TPI - Turfgrass Producers International; www.turfgrasssod.org.
193. TRI - Tile Roofing Institute; www.tileroofing.org.
194. UL - Underwriters Laboratories Inc.; www.ul.com.
195. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
196. USAV - USA Volleyball; www.usavolleyball.org.
197. USGBC - U.S. Green Building Council; www.usgbc.org.
198. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
199. WASTEC - Waste Equipment Technology Association; www.wastec.org.
200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
201. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
202. WDMA - Window & Door Manufacturers Association; www.wdma.com.
203. WI - Woodwork Institute; www.wicnet.org.
204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
205. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
2. ICC - International Code Council; www.iccsafe.org.
3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
3. DOE - Department of Energy; www.energy.gov.
4. EPA - Environmental Protection Agency; www.epa.gov.
5. FG - Federal Government Publications; www.gpo.gov/fdsys.
6. GSA - General Services Administration; www.gsa.gov.
7. HUD - Department of Housing and Urban Development; www.hud.gov.
8. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
9. OSHA - Occupational Safety & Health Administration; www.osha.gov.
10. SD - Department of State; www.state.gov.
11. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
12. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
13. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
14. 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 shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. USAB - United States Access Board; www.access-board.gov.
2. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Water Service: New water service from existing water meter pit on Project Site shall be installed as part of the Work of this Contract.

1. Contractors shall provide temporary water required for their on-site operations until new water service is usable.
2. Contractors may use Owner's new water system when it is operational and allowed by Authorities Having Jurisdiction.
3. All Prime Contractors shall pay an equal portion of the cost for metered use of Owner's water service.

C. Sewer Service: New sanitary sewer system connected to existing piping in roadway just outside of the Project Site shall be installed as part of the Work of this Contract.

1. Contractors may use Owner's new sewer system when it is operational and allowed by Authorities Having Jurisdiction.
2. Provide connections and extensions of services as required for construction operations.

D. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

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

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

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: 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 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feethigh with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-milminimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of 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 8 individuals. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
4. Lighting fixtures capable of maintaining average illumination of 20 fcat desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 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 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 01 7700 "Closeout Procedures".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Connect to Owner's water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to like-new condition.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. 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.

E. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. Electric Power Service: When permanent service is available provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

H. 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.

I. Telephone Service: General Contractor's superintendent shall be provided with a cellular telephone capable of sending and receiving text messages, e-mail, photographs, and telephone calls.

J. Electronic Communication Service: Provide a desktop, laptop or convertible tablet computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

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: Provide WiFi hotspot with a minimum of 20mps download speed. WiFi shall be accessible to Owner and Architect.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Recondition base after temporary use, including removing contaminated material, regrading, proof-rolling, compacting, and testing.
3. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course.

D. 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.

E. Parking: Construction personnel shall be responsible for finding and paying for legal parking at and/or around the site. No construction vehicles shall block or otherwise impede public ways, drives or intersections without previous written permission from the authority having jurisdiction.

F. 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.

G. 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. Project Identification Sign: Provide minimum 8' x 4' project sign mounted on pressure treated 4' x 4' posts with adequate bracing. Project sign design shall be developed by Architect. Sign shall be painted or adhered to a minimum 3/4" plywood backing.
4. Maintain and touchup signs so they are legible at all times.

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 01 7300 "Execution."

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. 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, according to erosion- and sedimentation-control Drawings.

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: 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.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

J. 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.

K. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Protect air-handling equipment.
3. Provide walk-off mats at each entrance through temporary partition.

3.5 MOISTURE AND MOLD CONTROL

A. Exposed Construction Phase: 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.

B. Partially Enclosed Construction Phase: 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, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

C. Controlled Construction Phase of Construction: 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 permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.

c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 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. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

END OF SECTION 01 5000

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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 01 2500 "Substitution Procedures" for requests for substitutions.
2. Section 01 4200 "References" for applicable industry standards for products specified.

1.3 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. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product. The Architect and Owner will have final approval whether or not products are comparable. Products will not be considered comparable when the Owner will be required to maintain an attic stock or maintenance stock of two similar/equal/comparable products that perform that same function but are not compatible or do not physically relate to one another. Example: The existing electrical system utilizes manufacturer A's breakers and panels but manufacturer B is submitted for all new breakers and panels thus requiring the Owner to maintain a maintenance stock of two different breakers. In this case manufacturer B is not comparable.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Section 01 3300 "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 3300 "Submittal Procedures." Show compliance with requirements.

1.5 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 existing or previously selected, even if previously selected products were also options.

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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 with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 7700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. 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.
2. 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.
3. Products:

    a. Restricted List: 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.
    b. Nonrestricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

a. Restricted List: 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.
b. Nonrestricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. 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 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.

C. Visual Matching Specification: Where Specifications require "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 01 2500 "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 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.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: 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 these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - EXECUTION

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 general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:

1. Section 01 1000 "Summary" for limits on use of Project site.
2. Section 07 8413 "Penetration Firestopping" for patching penetrations in 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 construction to original conditions after installation of other work.

1.4 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: 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.

B. 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.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: 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.

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, 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. 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 local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 3100 "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. If discrepancies are discovered, notify Architect promptly.

B. General: Owner will provide a land surveyor to establish benchmarks and control points for construction of building foundation, column lines, and site improvements.

C. Contractor is required to provide and update a schedule and scope for construction surveying services at least 5 (five) working days prior to the date survey is needed.

D. Contractor will be responsible for all other building interior layout needs.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Preserve and protect permanent benchmarks and control points during construction operations.

1. Report lost or destroyed permanent benchmarks or control points promptly.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

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: Do not use tools or equipment that produce harmful 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 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.

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. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, 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. 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.

F. 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. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. 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.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

   a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: 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 01 7419 "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 assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 9113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.10 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. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 7300

SECTION 01 7419 - 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 31 1000 "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 and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

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 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.4 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. 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. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
4. 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 (Not Used)

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. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 01 5000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
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.

B. Salvaged Items for Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:

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 on-site 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 accrue to Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 4-inch size.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 4-inch size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

D. 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.

E. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

F. Conduit: Reduce conduit to straight lengths and store by type and size.

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.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 01 7419

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 01 7300 "Execution" for progress cleaning of Project site.
2. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Section 01 7900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, 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 where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 7900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
8. Complete final cleaning requirements, including touchup painting.
9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 01 2900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect 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 will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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.

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 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.

f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. 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.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.

a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 7700

SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Section 01 3300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. Organize operations and maintenance manuals following the example template provided in 01 7823a, "Operation and Maintenance Manual Template."

2. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

3. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return three copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. 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: Enable bookmarking of 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.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. 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.

C. 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.

D. 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.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. 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.

B. 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.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.

4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
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. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

F. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7823

[Insert PROJECT PHOTO here
Or Delete Box]

OPERATION & MAINTENANCE MANUAL

[**PROJECT NAME**]

[**PROJECT ADDRESS LINE 1**]

[**PROJECT ADDRESS LINE 2**]

Date of Substantial Completion: [Insert date]

Contractor: [COMPANY NAME]

[Contact Name]
[TITLE]
[ADDRESS LINE 1]
[ADDRESS LINE 2]
[PHONE #]
[FAX #]
[EMAIL]

Architect: Manns Woodward Studios, Inc.
Architect of Record: David Woodward, Principal

10839 Philadelphia Road, Suite D
White Marsh, Maryland 21162
PHONE: 410-344-1460
FAX: 443-403-2460
email: dwoodward@mwsarch.com

Insert **PROJECT NAME** here

OPERATION & MAINTENANCE MANUAL

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Required Maintenance Schedules ……..5

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Demonstration and Training attendance sign offs ……9

Division 02 – Demolition ……..……10

[Items returned to owner]……..11

[Recycled Items]…….....12

[Salvaged Items]…….....13

Division 03 - Concrete……..…….....14

[Insert Items]

(list each Division and their subdivisions individually, and page number where each starts)

Division 04 - Masonry……..…….....[###]

[Insert Items]…….[###]

Division 05 - Metals……..…….....[###]

[Insert Items]……..…[###]

Division 06 – Wood and Plastics……..…….....[###]

[Insert Items]……..……[###]

Division 07 – Thermal and Moisture Protection……..…….....[###]

[Insert Items]……..…[###]

Division 08 – Doors and Windows ……[###]

[Insert Items]……..[###]

Division 09 – Finishes ……[###]

[Insert Items]……..[###]

(continue to list each of Division and their subdivisions individually)

As Built Drawings ……..300
Civil ……325
Architectural ……360
Structural ……..410
Mechanical ……..454
Electrical ……506
Plumbing ……557
Sprinklers ……582

How to use this O&M Manual Template

1. Format the O&M Manual to follow the appearance and specific order of this example template in this order:
    a. Title Page.
    b. Table of Content Page.
    c. Project Directory Page.
    d. General Warranty Page.
    e. Required Maintenance Schedules Page(s).
    f. The following data for all specified finishes, materials, equipment, and systems that the Owner will require for operation, maintenance, and warranty references (organized individually by CSI Division and then by sub-division):
        i. Submittals, with review comments (product data, shop drawings, etc).
        ii. Warranty certificates.
        iii. Operation manuals.
        iv. Maintenance instructions.
        v. MSDS forms.
        vi. As-Built drawings.
2. Text appearing **[in brackets like this]** inside this template indicates text that the General Contractor must customize to suit the project and their company.
3. Generate the O&M Manual by computer, using a combination of typed-format word processor files and scanned PDF documents. Make a final version of the O&M Manual in a single PDF file (or one PDF file for each O&M volume, if it is split into 2 or more volumes).
4. Format the O&M Manual PDF version as described in the Specifications, using an 8 ½" x 11" size portrait layout so that the Owner may easily print portions of the PDF on any standard printer without the need for special paper (this does not apply to attached submittals that were formatted using other paper sizes – these should remain at their original paper size).
5. Deliver the O&M Manual to the Owner in PDF form, plus bound hardcopies if so indicated in the Project Specifications.

Additional Notes:

1. Format the PDF version with "Hyperlinks" or "Bookmarks" in the Table of Contents, so that the Owner can click on the name of an item in the TOC and go straight to that item.
    - **What is a Hyperlink?** A hyperlink is an active piece of text in the PDF, usually easily identified by blue text color and underlining, that will "jump" to either a specific section of the PDF or out to a separate file or web address when it is double-clicked. **If using Hyperlinks,** use them for every item in the Table of Contents so that the viewer can jump to the beginning of each referenced section of the O&M Manual directly from the TOC.

- **What is a Bookmark?** A bookmark is also a type of link, similar to a hyperlink, that jumps to a specific place in the PDF. Bookmarks only work inside of the PDF and cannot link to web addresses or external files, unlike hyperlinks. **If using Bookmarks,** use them for every item in the Table of Contents so that the viewer can jump to the beginning of each referenced section of the O&M Manual directly from the TOC.

2. If the O&M Manual must be hardcopy printed, follow the Specifications requirements, plus the following, unless the Specs say otherwise:
    a. Use 3-ring binders with page-lifters. Binders must not be wider than 3 inches. If the entire O&M will not fit in (1) 3-inch binder, use multiple volumes. Use identical new binders.
    b. Label the front and spine of every binder with typed, computer-generated labels. In addition to the project name and other required details, identify each volume individually on the labels.
    c. Provide a Table of Contents in the front of every volume. Each volume's TOC must list only that volume's contents.
    d. Use heavy-duty clear sheet protectors for the TOC, and for the As-Built Drawings, for durability.
    e. Separate each CSI Division in the O&M Manual using cardstock or stiff plastic dividers with labeled tabs projecting out of the document.
    f. Put page breaks between every individual package of materials to separate them from each other. All materials related to one item should be grouped together (for instance, vinyl floor tile product data, color and item number, warranty certificate, maintenance instructions, and MSDS form for floor polish).
    g. It is acceptable to print double-sided to reduce paper. *However,* every package of related materials (for instance, all of the materials for vinyl floor tile) must start on a new page.

DO NOT INCLUDE THIS INFORMATIONAL SECTION IN THE FINAL O&M MANUAL TO BE GIVEN TO THE OWNER.

PROJECT DIRECTORY

[PROJECT NAME]

[PROJECT ADDRESS LINE 1]
[PROJECT ADDRESS LINE 2]

OWNER

[COMPANY NAME]

[COMPANY ADDRESS LINE 1]
[COMPANY ADDRESS LINE 2]

	Business Phone	Mobile Phone	Email address
[John Doe, title]	[410-444-1111]	[443-444-2222]	[Jdoe@companyname.com]
[Jane Doe, title]	[410-444-2222]	[443-444-3333]	[jadoe@companyname.com]

GENERAL CONTRACTOR [CONSTRUCTION MANAGER]

[COMPANY NAME]

[COMPANY ADDRESS LINE 1]
[COMPANY ADDRESS LINE 2]

	Business Phone	Mobile Phone	Email address
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[Jane Doe, title]	[410-444-2222]	[443-444-3333]	[jadoe@companyname.com]

ARCHITECT

Manns Woodward Studios
10839 Philadelphia Road, Suite D
White Marsh, Maryland 21162

	Business Phone	Mobile Phone	Email address
Robert Manns, Principal	410-344-1460	410-917-5158	rmanns@mwsarch.com
David Woodward, Principal	410-344-1460	443-643-7249	dwoodward@mwsarch.com
James Magnuson, Principal	410-344-1460	443-963-4701	jmagnuson@mwsarch.com

DESIGN TEAM (List each of the design team individually)

Civil Engineer: [COMPANY NAME]
[ADDRESS LINE 1]
[ADDRESS LINE 2]

	Business Phone	Mobile Phone	Email address
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[Jane Doe, title]	[410-444-2222]	[443-444-3333]	[jadoe@companyname.com]

Structural Engineer: [COMPANY NAME]
[ADDRESS LINE 1]
[ADDRESS LINE 2]

	Business Phone	Mobile Phone	Email address
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[Jane Doe, title]	[410-444-2222]	[443-444-3333]	[jadoe@companyname.com]

Mechanical / Electrical / Plumbing Engineer: [COMPANY NAME]
[ADDRESS LINE 1]
[ADDRESS LINE 2]

	Business Phone	Mobile Phone	Email address
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[Jane Doe, title]	[410-444-2222]	[443-444-3333]	[jadoe@companyname.com]

SUB CONTRACTORS (List each subcontractor individually)

[Subcontractor Type]: [COMPANY NAME]
[ADDRESS LINE 1]
[ADDRESS LINE 2]

	Business Phone	Mobile Phone	Email address
[John Doe, title]	[410-444-1111]	[443-444-2222]	[Jdoe@companyname.com]
[Jane Doe, title]	[410-444-2222]	[443-444-3333]	[jadoe@companyname.com]

[Contractor's Company Name] Warranty

[January 1, 2000]

[Owner's Company Name]

[Project Address Line 1]

[Project Address Line 2]

Substantial Completion Date: [Date]

Attention: [Owner's Name]

[Owner's Name],

Sample Warranty:

(Body Text)

(Body Text)

(Body Text)

(Body Text)

(Body Text)

(Body Text)

[Salutation],

[Contractor name]

[Title]

REQUIRED MAINTENANCE SCHEDULES

[PROJECT NAME]

[**PROJECT ADDRESS LINE 1**]
[**PROJECT ADDRESS LINE 2**]

(Include all required maintenance in equipment and finishes in project.)

Division 08
Doors and Windows

(Sample Division Cover Page – print on cardstock divider with numbered tab.

Hyperlink or bookmark this tab in the Table of Contents.)

Division 08

Door Hardware

(Content should include all related items required by the Specifications)

[Sample]

Division 09
Finishes

(Sample Division Cover Page – print on cardstock divider with numbered tab.

Hyperlink or bookmark this tab in the Table of Contents.)

Division 09

Ceramic Tile

(Content should include all related items required by the Specifications)

[Sample]

SECTION 01 7839 - 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 Product Data.
3. Miscellaneous record submittals.

B. Related Requirements:

1. Section 01 7300 "Execution" for final property survey.
2. Section 01 7700 "Closeout Procedures" for general closeout procedures.
3. Section 01 7823 "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 copies of record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints and one of file prints.

b. Final Submittal:

1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. 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.

C. 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.

PART 2 - PRODUCTS

2.1 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.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations below first floor.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.2 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.3 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 scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 7839

SECTION 01 7900 - 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 paper and PDF file format required for operation and maintenance manuals specified in Section 01 7823 "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 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "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 01 7823 "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.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.

1. Submit video recordings on CD-ROM or thumb drive.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 7900

SECTION 03 3000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes the following:

1. Foundations.
2. Slabs-on-grade.
3. Equipment pads and bases.
4. Slab on metal form

1.3 DEFINITIONS

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

B. Integral Waterproofing Admixtures (IWPA): Concrete admixture that reacts with the calcium hydroxide created by the Portland cement reaction with water and the free water in concrete to eliminate the route of water ingress making the concrete impermeable.

C. Water Vapor Reducing Admixtures (WVRA): Concrete admixture that reacts with the calcium hydroxide created by the Portland cement reaction with water and the free water in concrete to eliminate the route of moisture migration and eliminate the free water chemically.

D. W/C Ratio: The ratio by weight of water to cementitious materials.

1,4 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections except that the number of copies of submittals shall be limited to a maximum of five.

B. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement.

1. Shop drawings shall not be reprints of the contract drawings.
2. Contractor shall review and approve shop drawings prior to submission for A/E review. Only shop drawings bearing the stamp of the contractor, indicating that such a review has been done, will be reviewed by the A/E.

C. Laboratory test reports for concrete materials and mix design test.

D. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

5. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
6. ACI 318, "Building Code Requirements for Reinforced Concrete."
7. ACI 311, "Recommended Practice for Concrete Construction."
8. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
9. ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures."
10. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
11. Current IBC Code.

B. Concrete Testing Service: Engage a testing agency acceptable to Architect to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

B. Forms for Unexposed Finish Concrete (Footings): Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615 Grade 60, deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

D. Supports for Reinforcement: 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 specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

2. Cementitious material for all concrete slabs-on-grade shall be 100% Portland Cement, and shall be a minimum of 75% Portland Cement for other concrete.

B. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete. For exposed exterior surfaces do not use fine or coarse aggregate that contains substances that cause spalling.

C. Water: Potable.

D. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

1. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
2. Water-Reducing Admixture: ASTM C 494, Type A.
3. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
4. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
5. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
7. Water Vapor Retarding Admixture: ASTM C494, Type S.
8. Corrosion Inhibiting and Waterproof Conc. Admixture: ASTM C494, Type S.

E. Synthetic Micro-Fibers: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C1116, Type III, ½ to 1½" long.

2.4 RELATED MATERIALS

A. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. m when applied at 200 sq. ft./gal (4.9 sq. m/L).

B. Water-Based Acrylic Membrane Curing Compound: ASTM C 309,Type I, Class B.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.

C. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

D. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9oz/sq. yd. when dry.

E. Moisture Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

F. Bonding Agent: Polyvinyl acetate or acrylic base.

G. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

H. Penetrating Liquid Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates,hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Masterseal SL 40 VOC; Master Builders
   b. Chemsil Plus; ChemMasters
   c. Euco Diamond Hard; Euclid Chemical Co.
   d. Seal Hard; L&M Construction Chemicals, Inc.
   e. Day-Chem Sure Hard; Dayton Superior Corporation

I. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

J. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

K. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

L. Water Vapor reducing Admixture (WVRA): ASTM C494 Type S; complex catalyzed hydrous silicate, waterproofing and vaporproofing liquid admixture for use in concrete if required for compatibility with floor finishes.

Basis of design product to be SPG Specialty Products Group Vapor Lock 20/20.

M. Integral waterproofing Admixture (IWPA): ASTM C494 Type S, couples catalyzed silicate water and vapor proofing liquid admixture.

Basis of deign product SPG Specialty Products Group Vapor Lock 20/21.

N. Corrosion Inhibiting and Waterproof Concrete Admixture ASTM C494 Type S: Commercially formulated to use Volatile Organic Compound (VOC) free proprietary technologies that act as a corrosion inhibitor while water and vapor proofing concrete.

Basis of product SPG Specialty Products Group Vapor Lock 40/40.

O. Granular Fill: Granular fill beneath slab-on-grade to be a clean mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448, size 57, with 100 percent passing a 1½" sieve and 0 to 5 percent passing and No 8 sieve.

2.5 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

1. Do not use the same testing agency for field quality control testing.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:

1. 4000 psi, 28-day compressive strength; water-cement ratio, 0.51 maximum (non-air-entrained), 0.40 maximum (air-entrained).
2. 3000 psi, 28-day compressive strength; water-cement ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained).
3. 4500 psi, 28-day compressive strength; water-cement ratio, .40 maximum (air-entrained

D. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:

1. Subjected to freezing and thawing: W/C 0.45.
2. Subjected to deicers/watertight: W/C 0.40.
4. Subjected to brackish water, salt spray, or deicers: W/C 0.40.

E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches
3. Concrete containing high-range water-reducing admixture (super-plasticizer): Not more than 8 inches after adding admixture to site-verified 2 - 3 inch slump concrete.
5. Other concrete: Not more than 4 inches.

F. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

G. Synthetic Micro-Fibers: Uniformly dispense in concrete mix for 8" slabs-on-grade at manufacturer written instructions at a rate of 1.5 lbs/ou. yds.

2.6 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (super-plasticizer) in concrete, as required, for placement and workability. Note that for the 8" slabs-on-grade, use a mid-range dose of high range water-reducing admixrure.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F.

C. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:

1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals:

    a. 4.5 percent (moderate exposure); 5.5 percent (severe exposure) for 11/2 inch maximum aggregate.
    b. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) for 1 inch maximum aggregate.
    c. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) for 3/4 inch maximum aggregate.
    d. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) for 1/2 inch maximum aggregate.

2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

D. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

E. Water Vapor reducing Admixture (WVRA): ASTM C494 Type S; complex catalyzed hydrous silicate, waterproofing and vaporproofing liquid admixture for use in concrete if required for compatibility with floor finishes.

1. Basis of design product to be SPG Specialty Products Group Vapor Lock 20/21 or 20/20.

G. Use corrosion inhibiting and waterproofing admixture in 12" thick concrete slab-on-grade.

1. Basis of design product to be SPG Specialty Products Group Vapor Lock 20/21 or 40/40.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (29 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and 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

A. Coordinate the installation of joint materials, vapor retarder, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

1. Provide Class A tolerances for concrete surfaces exposed to view.
2. Provide Class C tolerances for other concrete surfaces.

B. Fabricate forms for easy removal without hammering or prying against concrete surfaces.

C. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

D. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

E. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER INSTALLATION

A. Install vapor barrier per Division 07 Section "Vapor Barriers".

3.4 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.

D. Place reinforcement to maintain minimum coverage as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect.

B. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

C. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch12 mm or more than 1 inch25 mm below finished concrete surface where joint sealants, specified in Division 7 Section "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.

D. Contraction Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/4 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting pre-molded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
3. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."
4. If joint pattern is not shown, provide joints not exceeding 15 ft. in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

3.6 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, non-residual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

3.8 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

3.10 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, and where indicated.

1. After placing slabs, finish surface to tolerances of F(F) 30 (floor flatness) and F(L) 20 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; and where indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 30 (floor flatness) and F(L) 20 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, or ceramic tile.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and

appearance, and finish surfaces to tolerances of F(F) 30 (floor flatness) and F(L) 20 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

D. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

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

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

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, 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 shown or required to complete Work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.

D. Provide moisture curing by the following methods:

1. Keep concrete surface continuously wet by covering with water.
2. Use continuous water-fog spray.
3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4 inch lap over adjacent absorptive covers.

E. Provide moisture-retaining cover curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Apply curing compound on exposed interior slabs as follows:

1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

3.13 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to Manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if the surface is rough or pourous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compond to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of column pedestals, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

3.15 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Architect.

B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.

2. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

C. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

D. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

F. Repair methods not specified above may be used, subject to acceptance of Architect.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: The Contractor will employ a testing agency, acceptable to the architect, to perform tests and to submit test reports.

B. Sampling and testing for quality control during concrete placement may include the following, as directed by Architect.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
    a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

b. Air Content: ASTM C 173, volumetric method or ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
d. Compression Test Specimen: ASTM C 31; one set of seven standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, three specimens tested at 28 days, and three specimens retained in reserve for later testing if required.

2. When frequency of testing will provide fewer 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.
3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
4. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

C. Inspections: For concrete containing WVRA, provide the following:

1. Moisture Testing: Conducted by WVRA manufacturer or appointed representative prior to installing moisture-sensitive coatings and adhesives. No other moisture testing by installers is required.

2. Bond Testing: Conducted by WVRA manufacturer or appointed representative on moisture-sensitive materials installed by Contractor.
pH Testing: Conducted by WVRA manufacturer or appointed representative.

3. Report test results in writing to Architect and Contractor within 48 hours of testing.

4. Authorization to install moisture-sensitive coatings and materials must be obtained in writing from WVRA manufacturer

C. Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03 3000

SECTION 04 2000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Exterior pavers.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For 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 exposed masonry unit and colored mortar.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include material test reports substantiating compliance with requirements.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 4000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior wall in sizes approximately 60 inches long by 48 inches high by full thickness.

1.6 FIELD 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. 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.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

C. Contractor shall be responsible for hot and / or cold weather procedures without additional costs to the Owner. Implementation of such procedures shall not be cause for Change Orders. The General Contractor shall be responsible for the timing of masonry construction operations, and the need for hot and / or cold weather requirements, as necessary to maintain the overall Project Schedule.

PART 2 - PRODUCTS

2.1 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.

1. General Contractor shall be required to replace at no additional cost to the Owner all installed units showing defects consisting of spalls or "pop outs" within the warranty period.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 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, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

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. ACM Chemistries; RainBloc.
b. BASF Corporation-Construction Systems; MasterPel 240 (Pre-2014: Rheopel Plus) or MasterPel 200HD (Pre-2014: Rheopel 200HD).
c. Grace Construction Products; W.R. Grace & Co. -- Conn.; Dry-Block.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of not less than 1,900 psi,but not less than required to achieve an f'm = 1,500 psi.
2. Density Classification: Lightweight, medium weight, or normal weight, subject to compliance with compressive strength requirements.

D. Decorative CMUs: ASTM C 90.

1. Split Face CMU

a. Products: Subject to compliance with requirements, provide the following:

1) Westbrook Concrete Block; Split Face Units with Pozzotive.

b. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of not less than 1,900 psi per ASTM C90, but not less than required to achieve an f'm = 1,500 psi.
c. Density Classification: Normal weight.
d. Aggregates: ASTM C33.
e. Sampling and Testing for Concrete Masonry Units: ASTM C140.
f. Water Penetration: ASTM E514.
g. Pattern and Texture:

1) Standard pattern, split-face finish.

2) Specialty shapes: Manufacturer¢s pre-finished inside and outside corners, for use at door and window jamb openings, and where split face CMU is used as an outside corner.

h. Water Repellent: Factory-applied to units after fabrication, or integral to manufacture of units.
i. Color: As selected by Architect from Manufacturer¢s full range.

2. Ground Face CMU

a. Products: Subject to compliance with requirements, provide the following:

1) Westbrook Concrete Block; Ground Face Masonry Units with Pozzotive.

b. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of not less than 1,900 psi per ASTM C90, but not less than required to achieve an f'm = 1,500 psi.
c. Density Classification: Normal weight.
d. Aggregates: ASTM C33.
e. Sampling and Testing for Concrete Masonry Units: ASTM C140.
f. Water Penetration: ASTM E514.
g. Pattern and Texture:

1) Specialty shapes: As indicated in the Drawings, with pre-finished inside and outside corners where exposed to view.

h. Water Repellent: Factory-applied to units after fabrication, or integral to manufacture of units.

1) Color: As selected by Architect from Manufacturer¢s full range.

2.3 CONCRETE LINTELS

A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

2.4 EXTERIOR PAVERS

A. Material: Natural bluestone, fine textured Type II Quartzite Sandstone comprised primarily of silicone dioxide, aluminum oxide, iron oxide, and calcium oxide; ASTM C 616; quarried in either Pennsylvania or New York.

1. Water Absorption: No greater than 1.21% after 48 hours, per ASTM C-121-48.
2. Slipperiness (Wet/Dry): 28.2 for thermal face finish.
3. Compressive Strength: No less than 18,000 psi across strata, and 12,300 psi with strata.

4. Flexural Strength: No less than 2,900 psi across strata, and 2,100 psi with strata.
5. Modulus of Rupture: PAR/PL 2486, and ASTM C 99.
6. Abrasion Resistance: 18 to 32, per ASTM C 241-51.
7. Weight: 167 pounds per cubic foot.

B. Color: Uniform, dark-blue range. Variegated and full-range color is not acceptable, and shall be rejected.

C. Thickness: 1-1/2 inch, gaged to a uniform thickness before finishing.

D. Size: Sizes indicated, and where not indicated, 24 by 24 inch nominal allowing for joint widths indicated, with sawn edges.

E. Texture and Finish:

1. Top: Thermal finish on honed surface.
2. Side Edges: Sawn.
3. Bottom: Gaged.

F. Available Manufacturers: Subject to compliance with requirements, available manufacturers include, but are not limited to, the following:

1. Sandy Neck Stone; Bluestone Patio Stone (Basis of Design).
2. Gettysburg Stoneworks.
3. Meshoppen Stone, Inc.
4. Pavingstone Supply, Inc.
5. Schofield Stone (Geo. Schofiled Co., Inc.)

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, 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.

B. Hydrated Lime: ASTM C 207, Type S.

C. Masonry Cement: ASTM C 91/C 91M.

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. Cemex S.A.B. de C.V.; .
b. Essroc; Brixment.
c. Holcim (US) Inc; Mortamix Masonry Cement.
d. Lafarge North America Inc.; Lafarge Masonry Cement.
e. Lehigh Hanson; HeidelbergCement Group; Lehigh Masonry Cement.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.

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. Davis Colors; True Tone Mortar Colors.
b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
c. Solomon Colors, Inc.; SGS Mortar Colors.

E. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

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) Essroc; Riverton Portland Cement Lime Custom Color.
2) Holcim (US) Inc; Rainbow Mortamix Custom Color Cement/Lime.
3) Lafarge North America Inc.; Eaglebond Portland & Lime.
4) Lehigh Hanson; HeidelbergCement Group; Lehigh Custom Color Portland/Lime Cement.

2. Colored Masonry Cement:

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) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
2) Essroc; Brixment-in-Color.
3) Holcim (US) Inc; Rainbow Mortamix Custom Color Masonry Cement.
4) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
5) Lehigh Hanson; Heidelberg Cement Group; Lehigh Custom Color Masonry Cement.

F. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16sieve.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Euclid Chemical Company (The); an RPM company; Accelguard 80.
b. Grace Construction Products; W.R. Grace & Co. -- Conn.; Morset.

I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

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. ACM Chemistries; RainBloc for Mortar.
b. BASF Corporation-Construction Systems; MasterPel 240MA (Pre-2014: Rheopel Plus Mortar Admixture) or MasterPel 210D (Pre-2014: Rheopel Plus D).
c. Grace Construction Products; W.R. Grace & Co. -- Conn.; Dry-Block Mortar Admixture.

J. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Mill- galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

D. Masonry-Joint Reinforcement for Multiwythe Masonry:

1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer 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 A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized-steel wire.

D. Screw-In Veneer Anchors: Where indicated, provide individual units designed for screw-attachment to masonry, structural metal stud, or concrete substrates, comprised of a cold-drawn steel wire anchor loop and a formed steel sheet baseplate.

1. Wire Anchor Loop: 12-gage steel wire, ASTM A1064.A1064M; hot-dip galvanized, bent to a trapezoidal loop profile, of length necessary for imbedment in veneer wythe to the depth recommended by the manufacturer but in no case less than 1/2 of the depth of the veneer.
2. Baseplate: Carbon steel sheet metal, ASTM A1008/A 1008M, hot dip galvanized; 4 pre-punched holes for drill fastening to substrate; with pre-punched and deformed vertical slot to receive wire loop; no less than 8 inches in height, and allowing no less than 5 inches of vertical height adjustability of the wire anchor loop.
3. Basis-of-Design: Subject to compliance with requirements, provide Hohmann & Barnard; DW-10, or comparable product by another manufacturer.

E. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized-steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized-steel wire.

F. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

H. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch-thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch-diameter, hot-dip galvanized-steel wire unless otherwise indicated.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Section 07 6200 "Sheet Metal Flashing and Trim" and as follows:

1. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
2. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
3. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Copper-Laminated Flashing: 7-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

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) Advanced Building Products Inc.; Copper Fabric Flashing.
2) Hohmann & Barnard, Inc; Copper Fabric Flashing.
3) York Manufacturing, Inc; Multi-Flash 500.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 6200 "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.; Mortar Maze Cell Vent.
2) Heckmann Building Products, Inc.; No. 85 Cell Vent.
3) Hohmann & Barnard, Inc; QV Quadro-Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Locations: Provide continuous cavity drainage material within masonry wall cavity, directly on top of through wall flashing and protecting veneer weeps, at every through-wall flashing line, whether specifically indicated in the Drawings or not; and elsewhere where specifically indicated.

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. Advanced Building Products Inc.; Mortar Break II.
b. CavClear/Archovations, Inc.; CavClear Masonry Mat.
c. Heckmann Building Products, Inc.; Weep-Thru Mortar Deflector.
d. Hohmann & Barnard, Inc; Mortar Trap.
e. Mortar Net USA, Ltd; Mortar Net.

2.10 MASONRY CLEANERS

A. 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 cleaner manufacturer and manufacturer of masonry units being cleaned.

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. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
b. EaCo Chem, Inc.
c. PROSOCO, Inc.

2.11 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 portland cement-lime mortar unless otherwise indicated.
3. 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 C 270, 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. Refer to Structural Drawings for mortar types for all CMU walls.
2. For veneer masonry, use Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of mortar cement by weight.
3. Mix to match Architect's sample.

E. 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.

F. Grout for Unit Masonry: Comply with ASTM C 476.

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 C 476, Table 1.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.2 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-inchmaximum.

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 head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 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. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and 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 masonry units and hollow brick 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.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together as follows:

1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use tab-type reinforcement.
b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

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.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

1. Install cavity drainage material continuously at all through wall flashing locations, whether indicated in the Drawings or not.

E. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of 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: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level C 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, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.11 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. 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.
3. Protect adjacent surfaces from contact with cleaner.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.12 MASONRY WASTE DISPOSAL

A. Masonry Waste Recycling: Return broken CMUs to manufacturer for recycling.

B. 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 04 2000

SECTION 05 1200 – STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes structural steel and architecturally exposed structural steel.
B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
2. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.

1.3 SUBMITTALS

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

B. Original Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
4. Shop drawings shall not be reprints of the contract drawings. The contractor shall review shop drawings for compliance with the contract documents and for coordination among the various trades. No shop drawings shall be submitted for A/E review without the contractor's stamp, indicating that such a review has been made.

C. Qualification data for firms and persons specified in the "Quality Assurance"

Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Mill test reports for structural steel, including chemical and physical properties, signed by manufacturers certifying that their products, including the following, comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

C. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
2. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
3. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
4. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep

steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 SEQUENCING

A. Verify existing field conditions and existing field dimensions prior to fabrication.

B. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes, Plates, and Bars: As follows:

1. Miscellaneous Shapes, Plates, and Bars : ASTM A 36.
2. Wide Flange and WT Shapes: ASTM A 992 , Grade 50.

B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.

C. Hot-Formed Structural Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Type E or S, Grade B.

1. Weight Class: As indicated.
2. Finish: Black, except where indicated to be galvanized.

E. Carbon-Steel Castings: ASTM A 27, Grade 65-35, medium-strength carbon steel..

F. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Unheaded Rods: ASTM A 36.
2. Headed Bolts: ASTM F1554 Grade 36ksi, carbon-steel, hex-head bolts; and

carbon-steel nuts.
3. Headed Bolts: ASTM A 325, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
4. Washers: ASTM A 36.

G. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 GROUT

A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.

1. Camber structural steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
7. Verify existing field conditions and existing field dimensions prior to fabrication.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded.

C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

D. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.5 SHOP CONNECTIONS

A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to receive sprayed-on fireproofing.
4. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:

1. SSPC-SP 2 "Hand Tool Cleaning."
2. SSPC-SP 3 "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.8 SOURCE QUALITY CONTROL

A. Contractor will engage an independent testing and inspecting agency, acceptable to the architect, to perform shop inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine

compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option, except that ultrasonic inspection shall be performed for 100% of full penetration welds.

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
4. Ultrasonic Inspection: ASTM E 164.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
3. Verify that weld sizes, fabrication sequence, and equipment used for

architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

A. Contractor will engage an independent testing and inspecting agency, acceptable to the architect, to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option, except that ultrasonic inspection shall be performed for at least 25% of full penetration welds. Should any of the 25% tested fail inspection, the owner may, at his option, require that a higher percentage, up to 100%, be tested by ultrasonic inspection.

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
4. Ultrasonic Inspection: ASTM E 164.

3.6 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05 1200

SECTION 05 2100 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. K-series open-web steel joists.
2. KCS-series open-web joists.
3. Joist Girders.
4. Special shaped steel joists.
5. Joist accessories.

1.3 DEFINITIONS

A. Special Joists: Special shaped joists, or special loading conditions that invalidate SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide joists, joist girders, and special joists along with all connections capable of withstanding design loads within limits and under conditions indicated.

1.5 SUBMITTALS

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

B. Product Data for each type of joist, accessory, and product specified.

C. Shop Drawings showing layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories, splice and connection details, and attachments to other units of Work. Shop drawings shall not be reprints of the contract drawings. The contractor shall review shop drawings for compliance with the contract documents and for coordination among the various trades. No shop drawings shall be submitted for A/E review without the contractor's stamp indicating that such a review has been made.

D. Comprehensive engineering analysis for all special joists shall be signed and sealed by the qualified professional engineer responsible for its preparation.

E. Material certificates signed by joist manufacturer certifying that joists comply with SJI's "Specifications."

F. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing joists similar to those indicated for this Project and that have a record of successful in-service performance.

1. Manufacturer must be certified by SJI to manufacture joists conforming to SJI standard specifications and load tables.

2. Assumes responsibility for engineering of all special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

3. Professional Engineer Qualifications: A professional engineer who is legally authorized 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 joists that are similar to those indicated for this Project in material, design, and extent.

B. SJI Design Standard: Comply with recommendations of SJI's "Standard

Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders," applicable to types of joists indicated.

C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with requirements of SJI's "Specifications" for chord and web section material.

B. Welding Electrodes: Comply with AWS standards.

C. Steel Bearing Plates: ASTM A36.

2.2 PRIMERS

A. Primer: SSPC-Paint 15, Type I, red oxide; Federal Specification TT-P-636, red oxide; or manufacturer's standard shop primer meeting the performance requirements of either of these red-oxide primers.

2.3 STEEL JOISTS

A. Manufacture joists according to SJI's "Specifications," with steel angle top and bottom chord members, of joist types, end arrangements, and top chord arrangements indicated.

B Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members where shown for securing other work to steel joists.

D. Camber K-series steel joists according to SJI's "Specifications."

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

F. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

G. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications

2.4 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specifications for Joist Girders, in SJI's "Specifications", with steel-angle top and bottom chord members: of joist type and end and top-chord arrangements as indicated.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members where shown for securing other work to steel joists.

D. Camber joist girders according to SJI's "Specifications".

2.5 JOIST ACCESSORIES

A. Bridging: Bridging is schematically indicated. Detail and fabricate bridging according to SJI requirements.

1. Supply additional bridging to ensure stability of structure during construction period and as required for uplift loading indicated.

B. Supply miscellaneous accessories, including splice plates and bolts required by the joist manufacturer to complete the joist installation.

2.6 SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories to be primed as follows:

B. Surface Preparation: Either hand tool cleaning, SSPC-SP 2, or power tool cleaning, SSPC-SP 3.

C. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film thickness of not less than 1 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of joists. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's recommendations, and the requirements of this Section.

1. Space, adjust, and align joists accurately in location before permanently fastening.
2. Install temporary bracing and bridging, connections, and anchors to ensure joists are stabilized during construction.

C. Field weld joists to supporting steel framework and steel bearing plates. Coordinate welding sequence and procedure with placing of joists.

1. Comply with AWS requirements and procedures for welding, appearance

and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts at erection connections only, unless otherwise indicated.

B. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at beams and/or walls.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing agency employed and paid by Contractor will perform field quality-control testing.

B. Testing agency will report test results promptly and in writing to Contractor and Architect.

C. Testing and verification procedures will be required of field welds.

1. Bolted erection connections will be visually inspected.
2. Field welds will be visually inspected.
3. In addition to visual inspection, field welds will be inspected and tested according to AWS D1.1 and the following procedures:

    a. Radiographic Testing: ASTM E 94 and ASTM E 142.
    b. Magnetic Particle Inspection: ASTM E 709.
    c. Ultrasonic Testing: ASTM E 164.
    d. Liquid Penetrant Inspection: ASTM E 165.

D. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.

E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Touch Up Painting: Following installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by hand tool cleaning, SSPC-SP 2, or power tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

END OF SECTION 05 2100

SECTION 05 3100 – STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Steel roof deck.
2. Composite floor deck.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
2. Division 3 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel
3. Division 5 Section "Metal Fabrications" for framing openings with miscellaneous steel shapes.
4. Division 5 Sections "Structural Steel" and "Steel Joists."

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections except that the number of copies of submittals shall be limited to a maximum of five.

B. Product data for each type of deck, accessory, and product specified.

C. Original shop drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction. Shop drawings shall not be reprints of the contract drawings. The Contractor shall review shop drawings for compliance with the contract documents and for coordination among the

various trades. No shop drawings shall be submitted for A/E review without the Contractor's stamp, indicating that such a review has been made.

D. Product certificates signed by manufacturers of steel deck certifying that their products comply with specified requirements.

E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements,

manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. H.H.Robertson
2. Roof Deck, Inc.
3. United Steel Deck, Inc.
4. Vulcraft Div. of Nucor Corp.
5. Wheeling Corrugating Co., Div. of Wheeling-Pittsburgh Steel Corp.
6. New Millennium

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:

1. Galvanized-Steel Sheet: ASTM A 653 SQ, Grade 33, G 90, zinc coated according to ASTM A 924.
2. Deck Profile: Type WR, wide rib.
3. Profile Depth: 1-1/2 inches
4. Design Uncoated-Steel Thickness: As indicated
5. Span Condition: Triple span or more.
6. Side Joints: Overlapped.

2.3 COMPOSITE FLOOR DECK

A Composite Steel Floor Deck: Fabricate deck panels with integrally embossed or raised pattern ribs and interlocking side laps to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 28, the minimum section properties indicated, and the following:

1. Galvanized Steel Sheet: ASTM A 653 SQ, Grade 33, G 90, zinc coated according to ASTM A 924.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Triple span or more.

2.4 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.

C. Miscellaneous Roof Deck Accessories: Steel sheet, 0.0359-inch- thick minimum ridge and valley plates, finish strips, and reinforcing channels, of same material as roof deck.

D. Weld Washers: Manufacturer's standard uncoated-steel sheet weld washers, shaped to fit deck rib, 0.0598 inch thick with 3/8-inch minimum diameter prepunched hole.

E. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch- thick minimum, of same material as deck panels, with 1-1/2-inch-minimum deep level recessed pans and 3-inch-wide flanges. Cut holes for drains in the field.

F. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071-inch- thick minimum units, of same material as deck panels. Cut holes for drains in the field.

G. Steel Sheet Accessories: ASTM A 653 SQ, G 60 coating class, galvanized according to ASTM A 924.

H. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

I. Pour Stops: Steel sheet, of same material as deck panels, and of thickness and profile as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 PREPARATION

A. Locate decking bundles to prevent overloading of supporting members.

3.3 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, and requirements of this Section.

B. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.

C. Place deck panels flat and square and fasten to supporting framing without warp or deflection.

D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.

E. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

F. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work..

3.4 ROOF DECK AND COMPOSITE FLOOR DECK INSTALLATION

A. Fasten roof deck panels and non-composite form deck to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space welds an average of 12 inches apart, with a minimum of two welds per unit at each support.

B. Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 36 inches, using one of the following methods:

1. Mechanically fasten with self-drilling No. 10- diameter or larger carbon steel screws.
2. Fasten with 1-1/2-inch-long minimum welds.

C. End Bearing: Install deck ends over supporting framing with a minimum end

bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking, and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing agency employed and paid by the Contractor, and acceptable to the architect, will perform field quality-control testing.

B. Field welds will be subject to inspection.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.

B. Provide final protection and maintain conditions to ensure steel decking is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

SECTION 05 4000 – COLD FORMED METAL FRAMING

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior non-load-bearing cold-formed metal stud walls and all other cold-formed framings components referenced on the structural drawings.

1.3 PERFORMANCE REQUIREMENTS

A. AISI "Specifications": Calculate structural characteristics of cold-formed metal framing according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members" and the following:

1. Center for Cold-Formed Steel Structures (CCFSS) Technical Bulletin, Vol. 2, No. 1, February 1993 "AISI Specification Provisions for Screw Connections."

B. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings and other structural data. Refer to structural drawings for design criteria.

1.4 SUBMITTALS

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

B. Product data for each type of cold-formed metal framing, accessory, and product specified.

C. Original shop drawings sealed and signed by the qualified professional engineer, registered in the jurisdiction where the project is located, who was responsible for their preparation, showing layout, spacing, sizes, thicknesses and types of cold-formed metal framing, fabrication, fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units of Work. Shop drawings shall not be reprints of the contract drawings. The contractor shall review shop drawings of compliance with the contract documents and for coordination among the various trades. No shop drawings shall be submitted for A/E review without the contractor's stamp, indicating that such a review has been made.

1. Include structural analysis data sealed and signed by the qualified professional engineer, registered in the jurisdiction where the project is located, who was responsible for its preparation.

D. Mill certificates signed by manufacturers of cold-formed metal framing certifying that their products comply with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, and galvanized-coating thickness.

1. In lieu of mill certificates, submit test reports from a qualified independent testing agency evidencing compliance with requirements.

E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Product test reports from a qualified independent testing agency evidencing compliance with requirements of the following based on comprehensive testing:

1. Expansion anchors.
2. Powder-actuated anchors.
3. Mechanical fasteners.

H. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence cold-formed metal framing's compliance with building code in effect for Project.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Fire-Test-Response Characteristics: Where fire-resistance-rated assemblies are indicated, provide cold-formed metal framing identical to that tested as part of an assembly for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory," or another testing and inspecting agency acceptable to authorities having jurisdiction.

E. Professional Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located, and experienced in providing engineering services of the kind indicated that have resulted in the installation of cold-formed metal framing similar to this Project in material, design and extent and that have a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:

1. Dale/Incor Industries, Inc.
2. Clarke Dietrich Industries, Inc.
3. MarinoWare; Div. of Ware Industries, Inc.
4. The Steel Network

2.2 MATERIALS

A. Galvanized-Steel Sheet: ASTM A 446, zinc coated according to ASTM A 525, and as follows:

1. Coating Designation: G 60
2. Grade: Grade A, 33,000 psi minimum yield strength, 20 percent elongation.
3. Grade: Grade D, 50,000 psi minimum yield strength, 12 percent elongation.

2.3 WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs of web depths indicated, with lipped flanges, and punched or unpunched webs.

B. Steel Track: Manufacturer's standard U-shaped steel track, unpunched, of web depths indicated, with straight flanges, and complying with the following:

1. Design Uncoated-Steel Thickness: Matching steel studs unless otherwise noted.
2. Flange Width: Manufacturers standard deep flange where indicated, standard flange elsewhere.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for

framing members, with minimum yield strength of 33,000 psi.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Gusset plates.
5. Vertical slide clips.
6. Stud kickers and girts.
7. Reinforcement plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by the hot-dip process according to ASTM A 123.

B. Cast-in-Place Anchor Bolts and Studs: ASTM A 307, Grade A; carbon-steel hex-head bolts and studs; carbon-steel nuts; and flat, unhardened-steel washers. Zinc coated by the hot-dip process according to ASTM A 153.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.

1. Fabricate framing assemblies in jig templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to manufacturer's recommendations.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.

C. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements, including installation tolerances and other conditions affecting performance of cold-formed metal framing. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.

C. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.

D. Provide temporary bracing and leave in place until framing is permanently stabilized.

E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

F. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and double studs, inaccessible upon completion of framing work.

G. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing agency employed and paid by Contractor, and acceptable to the architect, will perform field quality-control testing.

B. Field and shop welds will be subject to inspection and testing.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace Work that does not comply with specified requirements.

E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

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

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

END OF SECTION 05400

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Metal bollards.
4. Loose bearing and leveling plates for applications where they are not specified in other Sections.
5. Corrugated metal pipe used as a concrete-filled interior decorative column base.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

B. Templates for anchor bolts

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.5 COORDINATION

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

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

E. Steel Tubing: ASTM A 500, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.
2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.

H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

2.5 CORRUGATED METAL PIPE

A. Prefabricated, one-piece corrugated steel pipe, unperforated, spiral-formed from a continuous strip of steel sheet, with flat-locked spiral edges. ASTM A796.

B. Corrugation Type: Helical, 2-1/2 inch or 2-2/3 inch pitch x ½ inch deep corrugation profile.

C. Steel Thickness: 16 gage (0.064 inch).

D. Finish: Hot dip galvanized, with a minimum of 2 ounces per sq.ft. zinc coating, ASTM A929.

E. Diameter: As indicated.

F. Length: shop-cut to lengths indicated; and with exposed top and bottom cut edges shop-finished flat, smooth, uniform, and burr-free.

G. Basis-of-Design: Subject to compliance with requirements, provide Pacific Corrugated Pipe Company; Spiral Corrugated Metal Pie, or comparable product by another manufacturer.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carboline Company; Carboline 621
b. PPG Industries, Inc.; Aquapon Zinc-Rich Primer 97-670
c. Tnemec Company, Inc; Tneme-Zinc 90-97

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

E. Concrete: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.7 FABRICATION, GENERAL

A. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

B. Form exposed work with accurate angles and surfaces and straight edges.

C. 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.

D. 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.

E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, 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.

2.8 MISCELLANEOUS FRAMING, SUPPORTS, FABRICATED TRAINING PROPS

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.

1. Fabricate units from slotted channel framing where indicated.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with where indicated.

2.9 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.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize shelf angles located in exterior walls.

C. Prime shelf angles located in exterior walls with zinc-rich primer.

2.10 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.11 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

1. Fill bollards with concrete. Install a dome-shaped, pre-formed concrete cap with integral anchor at the time of concrete fill.

a. Concrete Cap

1) Basis of Design Product: Provide TopGuard Pipe Bollard Cap

a) Class A form finish
b) 5000 psi micro fiber reinforced concrete
c) Provide size to match bollard diameter.

2.12 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with zinc-rich primer.

2.13 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 1/12 of clear span but not less than 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.14 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.

2.15 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel itemsunless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless primers specified in Section 09 9600 "High-Performance Coatings" are indicated.

C. 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 INSTALLING 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.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

3.4 FABRICATING AND INSTALLING CORRUGATED METAL PIPE BASES

A. Fabrication:

1. Fabricate pipe bases only from non-damaged sections of corrugated metal pipe. Dented, non-round, and otherwise deformed sections of corrugated pipe are unacceptable.
2. Shop-cut and shop-finish individual pipe sections to lengths indicated. Use cutting tools and techniques that result in an annular cut that is square to the pipe axis, flat and true without tool marks on side of pipe, wavering edges or inconsistencies, metal deformation, and without notches, slivers, or burrs.
3. Shop-finish cut ends by grinding, abrading, or filing to remove sharp edges and burrs. Do not grind away galvanizing from exposed sides of corrugated pipe.
4. Remove mill markings and labels from outside of pipe.

B. Installation:

1. Before proceeding with installation, ensure both ends of pipe are cut square, flat, and uniform by resting cut ends on flat concrete slab and inspecting gaps where pipe meets slab. Remedy any gap or irregularity greater than 1/8 inch by re-finishing pipe ends.

2. Install in one piece over the tops of columns in locations indicated during steel erection process, just prior to connection of any structural members to columns that would interfere with one-piece installation of the pipes. Do not cut pipes to fit around columns.
3. Protect pipe bases from damage in-place using plywood and lumber framed enclosures, until ready for placement of concrete.
4. Locate pipe base so that post is exactly centered in the pipe. Temporarily brace in-place until concrete fill has been placed and consolidated. Use external bracing that may be removed without leaving exposed fastener holes or markings, or internal bracing that may be left in-place and abandoned, and that will not interfere with concrete placement.
5. Protect outside surfaces of corrugated metal pipe and adjacent floor surfaces from concrete spatter during filling with concrete.
6. Seal entire perimeter of interior side of joint between pipe and floor slab to prevent concrete from leaking under pipe.
7. Fill corrugated metal pipe with small aggregate concrete as indicated in the Drawings, to a level ¼ inch below the top of the corrugated pipe; vibrate, consolidate, and then steel-trowel the concrete to a level, smooth, uniform finish recessed ¼ inch below top of pipe. Ensure metal pipe does not move, shift, or become dislodged during concrete placement.
8. Immediately remove any concrete drips, runs, spatter, or spills from outside of corrugated metal pipe and adjacent floor surfaces, then clean thoroughly with sponge and clean water. Re-examine cleaned areas within 30 minutes after cleaning, and sponge-clean again if there is any evidence of cement paste residue or haze.
9. Protect installed corrugated metal pipe bases in-place until Substantial Completion.

3.5 INSTALLING BEARING AND LEVELING PLATES

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

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 5000

SECTION 05 5119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes industrial-type stairs and landings with steel-grating treads and landings.

1.2 RELATED SECTIONS

A. Section 05 7300 - Decorative Metal Railings•for premanufactured railing and guard systems mechanically attached to metal grating stairs.

1.3 ACTION SUBMITTALS

A. Product Data: For metal grating stairs.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments.

C. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design stairs, and structural reactions of railings specified in other sections where they attach to the stairs.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

C. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.2 METALS

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

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

E. Wire Rod for Grating Crossbars: ASTM A 510.

F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.4 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

C. Fabricate joints that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

D. Coordinate stair fabrication with attachment requirements and attachment locations of decorative metal railing systems, specified in other sections. Make provisions for attachment of decorative metal rails.

2.6 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel tubes and channels, as indicated.

    a. Provide closures for exposed ends of stringers.

2. Construct platforms of steel channel headers and miscellaneous framing members as indicated.
3. Weld stringers to headers; weld framing members to stringers and headers.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded steel grating with openings in gratings no more than 1/2 inch in least dimension.
2. Surface: Plain.
3. Finish: Galvanized.
4. Fabricate grating treads with cast-abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.7 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

C. Guards: Install decorative metal guards to stairs after installation of stairs, per requirements in Section 05 7300, - Decorative Metal Railings.•

3.2 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 5119

SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel pipe railings.

B. RELATED SECTIONS

1. Section 05 7300 - Decorative Metal Railings•for prefabricated metal railings and guards.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Cold-Formed Structural Steel: AISI "Specification for the Design of Cold-Formed Steel Structural members."
2. Steel: 72 percent of minimum yield strength.
3. Stainless Steel: 60 percent of minimum yield strength.

C. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on the followingollowing loads and stresses within limits and under conditions indicated:

1. Structural Computations
2. Design Data: Engineered drawings of metal stairs and railings with seal of Professional Engineer registered in the state where project is located.

D. Structural Performance of Handrails and Railings Systems: Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

1. Rail Loading:

a. Cap Rail of Guardrail Systems and Wall Railings: Capable of withstanding the following loads:

1) Concentrated load of 400 lbs/ft applied at any point in any direction.
2) Uniform load of 100 lbs per linear foot applied in any direction and concurrently with uniform load of 200 lbs per linear foot applied vertically downward.
3) Concentrated and uniform loads above need not be assumed to act concurrently.

b. Handrails not serving as Cap Rails: Capable of withstanding the following loads applied as indicated:

1) Concentrated load of 400 lbs per linear foot applied at any point in any direction.
2) Uniform load of 100 lbs per linear foot applied in any direction.
3) Concentrated and uniform loads above need not be assumed to act concurrently.

c. Infill Area of Guardrails Systems: Capable of withstanding a horizontal concentrated load of 200 lbs applied to 1 sq. ft. at any point in the system including panels, intermediate rails, balusters, or other elements composing th infill area.

1) Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress guard.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

F. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes on stainless steel.

D. Samples for Verification: For each type of exposed finish required.

1. Fittings and brackets.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of 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 such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 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: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed).

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors 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 according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 STEEL RAILING SYSTEM

A. Rails:

1. Standard weight steel pipe, closest size to O.D. indicated in the Drawings.

B. Posts:

1. Standard weight steel pipe, closest size to O.D. indicated in the Drawings.

C. Fitting: Elbows, Tees, wall brackets, escutcheons; machined steel

D. Mounting: Brackets and flanges, with steel inserts for casting in concrete with steel brackets for embedding in masonry or concrete.

E. Splice Connectors: Steel welding collars.

F. Brackets: Wall handle rail equal to Julius Blum and Co. malleable iron No. 306 or approved equivalent.

G. Hot Dipped galvanizing : 1.25 oz/sq. ft. zonc coating in accordance with ASTM A386

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

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. Shop Primers: Provide primers that comply with Section 09 9113 "Exterior Painting,"Section 09 9123 "Interior Painting," and Section 09 9600 "High-Performance Coatings."

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

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

2.6 FABRICATION

A. General: 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. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inchunless otherwise indicated. 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. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction as follows:

1. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

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 railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inchor less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide steel sleeves not less than 6 incheslong with inside dimensions not less than 1/2 inchgreater than outside dimensions of post, with metal plate forming bottom closure.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primerunless primers specified in Section 09 9600 "High-Performance Coatings" are indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. 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.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet
3. 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.

C. Corrosion Protection: 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.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

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 inchesbeyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inchesof post.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inchesdeep and 3/4 inchlarger than OD of post for installing posts in concrete slabs on grade. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inchclearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mildry film thickness.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 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.

END OF SECTION 05 5213

SECTION 05 7300 DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Component Aluminum railings.
2. Infill system for component aluminum railings.
3. Handrails used in connection with ornamental metal railings, including handrails attached to guards, and handrails attached to wall surfaces on opposite side of stair.

1.3 RELATED SECTIONS

A. 05 5119 - Metal Grating Stairs•for information on stairs to which Ornamental Metal Railings will be attached.

B. 05 5213 - Pipe and Tube Railings• for custom-fabricated, welded steel pipe and tube railings.

1.4 PERFORMANCE REQUIREMENTS

A. All railings shall be supplied to conform to applicable sections of the following codes:

1. International Building Code
2. ADAAG

B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill Area of Guards:

a. Horizontal concentrated load of 50 lbf applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Load on infill area need not be assumed to act concurrently with loads on top rails.

C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

E. Qualification Data: For professional engineer.

F. Product Test Reports: Supplier shall submit calculations and test reports for complete system, including railing and infill panels. Calculations and test reports shall be stamped by a licensed PE. Test reports shall be in accordance with ASTM E 935.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

B. Mock-up Panel: one section of railing system for verification.

1. Approximate Size: ¼ to ½ size using full size components.
2. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by architect in writing.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION AND SCHEDULING

A. 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 such items to project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Subject to compliance with requirements, provide Interna-Rail aluminum component railing as manufactured and assembled by Hollaender Manufacturing, or a comparable product by another manufacturer. Single source manufacturer is required. Welded railing will not be accepted.

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: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52, 6005-T5
1. Provide 1 ½ in IPS, (1.90 in OD) Standard Weight pipe for rails, Schedule 80 for posts, Schedule 10 for pickets, unless otherwise indicated

C. Extruded Structural Pipe and Round Tubing: ASTM B 429, Alloy 6061-T6.
1. Provide 1 ½ in IPS, (1.90 in OD) Standard Weight pipe for rails, Schedule 80 for posts, unless otherwise indicated

D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832

E. Plate and Sheet: ASTM B 209, Alloy 6061-T6

F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6

G. Base Flange Castings: ASTM B 26/B 26M, Alloy Almag 535

H. Panel Clips and Structural Fasteners: Alloy 6063-T6.

2.4 STEEL

A. Perforated Sheet: ASTM A1008.

2.5 FASTENERS

A. General: Provide the following:

1. Aluminum Railings: Alloy steel fasteners with JS-600 zinc plating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Structural Fasteners for Interconnecting Railing Components:

1. Rails shall be attached to posts by means of tee fittings equipped with anodized aluminum, tubular rivet nut and stainless steel socket head cap screw. All structural fasteners such as tee fittings shall be machined from 6063-T6 aluminum alloy. The fitting shall be internally connected to the rail by means of an internal dual tang that is expanded with a stainless steel, internal /external, reverse knurl, cup point socket head set screw. This combination shall prevent any loosening of the system due to changes in temperature or vibration. Systems using pop rivets or adhesives will not be accepted.

D. Fasten infill panels to rails and posts with Hollaender model 145 panel clips, machined from 6063-T6 aluminum alloy. Secure the infill panels in the panel clips with reverse-knurl cup-point set screws. Fasten panel clips to rails and posts with ¼ - 20 sheet metal screws.

E. Anchors: Provide concrete adhesive anchors where indicated or necessary.

2.6 INFILL FOR RAILINGS

A. Panel:

1. Welded Steel Wire Mesh infill panel: minimum .118 inch wire diameter steel
2. Pattern: 2• square.
3. Frame: steel U-channel, minimum 14 ga, corners welded and ground smooth. To assure minimum maintenance and maximum corrosion protection, bottom channel of frame shall be open, in order to evacuate all water.
4. Corrosion Protection

    a. Entire panel to be electro-coated. Electro-coating to be PPG Power cron 8000 or equivalent, and shall cover all exposed surfaces, especially interior of U channel. Electro-coating to be applied in four steps: pre-treatment, electro-coat, post rinse and bake oven.
    b. Entire panel shall then be powder coated with Silver powder coat, or equivalent powder coat color of architect¢s choice. Powder to be TGIC Polyester, minimum AAMA 2604.

5. Panels to be attached to railing using Hollaender #145 panel retainers and ¼ - 20 screws, with appropriate slot width for panel thickness, and set screw for final tightening of panel within retainer slot.

2.7 Handrails

A. Handrails shall be installed on both sides of each stair receiving Decorative Metal Rails, unless specifically indicated otherwise.

1. At guardrail locations, attach handrail to the guardrail sections using Hollaender model 85 adjustable brackets.

2. At wall locations, attach handrail to wall surfaces using appropriate Hollaender wall brackets, and non-corrosive fasteners and appropriate inserts or blocking necessary by the substrate to develop withdrawal strengths to exceed Building Code requirements for handrails.
3. Handrail will be anodized aluminum 6063 Sch. 40, 1 ½ in IPS nominal (1.90 in. OD) and shall have a continuous surface. Use longest lengths of handrail without joints as possible. Where necessary, lengths of the handrail will be spliced using Hollaender Model 70ES-8 internal locking splices.
4. Handrails shall return to a wall, guard or walking surface. If returning to the guard, Hollaender model 185 post return swivel shall be used to connect the end of the handrail to the guardrail post.

2.8 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.9 FABRICATION

A. General: 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. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. 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.

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. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items. Welding will not be accepted.

G. Connections: Fabricate railings with non-welded connections, unless otherwise indicated. Welding will not be accepted.

H. Non-welded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fittings to be of the internal double tang type activated by a reverse knurl cup point set screw. Reverse knurl is required to ensure that screw does not come loose under vibration. Plain cup point screws will not be accepted. Fittings to be fastened to pipe by means of a 5/16 in. tubular rivet nut and socket head cap screw.

I. Form changes in direction as follows:

1. By flush bends or by inserting prefabricated flush-elbow fittings.

J. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive 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 railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated. Flanges to be sand cast from aluminum alloy 535 with anodized finish and fastened directly to the post by means of two reverse knurl cup point set screws.

N. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.11 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Unless indicated otherwise, provide aluminum pipe with the following finish:

1. Anodized Finish: AA-M10C22A41 (Architectural class, .7 mil thickness or greater)

2.12 steel FINISHES

A. Wire Mesh Infill Panel:

1. Primer/Corrosion Protection - PPG Powercron 8000 or approved equal, applied in four-step process.
2. Finish: Powder coat

a. Color: as selected by Architect from manufacturer's full line. Powder coat to be TGIC-Polyester, min. AAMA 2603.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. 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.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. 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.

C. Corrosion Protection: 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.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Non-welded Connections: Use mechanical joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.

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 beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

3.4 ANCHORING RAILING ENDS

A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using non-welded connections.

3.5 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as indicated, or if not indicated, as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. Provide blocking between studs in stud wall construction.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.7 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 - 05 7300 DECORATIVE METAL RAILINGS

SECTION 06 1053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Wood furring and grounds.
3. Plywood backing panels.
4. Fire retardant treated (FRT) wood requirements.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Fire Retardant Treated (FRT) wood is required. Refer to Drawings for specific locations for FRT wood.

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, 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 above the ground in crawl spaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 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 as determined by testing identical products per test method indicated by a qualified testing agency.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

C. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Furring.
5. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 rade lumber and any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common rade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inchnominal thickness.

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. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: [ASTM C 1002] [ASTM C 954], length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 METAL FRAMING ANCHORS

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

B. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; 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 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Securely attach 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.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding orattaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.4 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 1053

SECTION 06 1600 - SHEATHING

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. Wall sheathing.
2. Roof sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to 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 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Continental Building Products, LLC.
c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. Temple-Inland Building Products by Georgia-Pacific.
f. USG Corporation.

2. Type and Thickness: Regular, 1/2 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.3 ROOF SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Continental Building Products, LLC.
c. Georgia-Pacific Gypsum LLC.
d. National Gypsum Company.
e. Temple-Inland Building Products by Georgia-Pacific.
f. USG Corporation.

2. Type and Thickness: Regular, 1/2 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.4 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 and wall sheathing, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

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 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Coordinate wall and 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.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 1600

SECTION 06 2023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Shelving.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20.

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.

2.2 INTERIOR TRIM

A. Hardwood Lumber Trim:

1. Species: White maple, unless indicated otherwise

2. Grade:

a. For Clear or Stained finish: NHLA “FAS-One-Face” or better.
b. For opaque finish: NHLA “Number 2A Common” without open or loose knots or checks in exposed surfaces.

3. Maximum Moisture Content: 9 percent.
4. Finger Jointing: Not allowed.

B. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA HWM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."

1. Species: White maple, unless indicated otherwise.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.

C. Molding Patterns:

1. Shall be as indicated on drawings.

2.3 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.

2.4 SHELVING

A. Exposed Shelving: Made from the following material, 3/4 inch thick.

1. Hardwood Veneer Plywood: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.

a. Face Veneer Species and Cut: Plain Sliced Maple or Birch.
b. Veneer Matching: Random match
c. Finish: Clear
d. Edging: Rectangular solid Maple or Birch edge, no less than ½ inch wide and matching shelf thickness, or as indicated in the Drawings.

2.5 MISCELLANEOUS MATERIALS

A. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

PART 3 - EXECUTION

3.1 PREPARATION

A. 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. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
4. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

3.4 SHELVING INSTALLATION

A. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.

END OF SECTION 06 2023

SECTION 06 4116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

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. Plastic-laminate-faced architectural cabinets.
2. Plastic-laminate-faced countertops.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 DEFINITIONS

A. Surface(s): Surfaces included all faces, edges, and ends.

B. Exposed Parts - Surfaces visible when:

1. drawer fronts and doors are closed;
2. cabinets and shelving are open-type or behind clear glass doors;
3. bottoms of cabinets are 42" or more above finished floor;
4. tops of cabinets are below 78' above finish floor, or are visible from upper floor or staircase after installation;
5. portions of cabinets are visible after fixed appliances are installed;
6. front edges of cabinet body members are visible or seen through a gap of greater than 1/8" with doors and drawers closed.

7. Semi-Exposed Parts - Surfaces visible when:

a. drawers/doors are in the open position;

b. bottoms of cabinets are between 30" and up to 42" above finished floor;
c. shelving behind doors.

8. Concealed Surfaces - Surfaces are concealed when:

a. surfaces are not visible after installation;
b. bottoms of cabinets are less than 30" above finished floor;
c. tops of cabinets are over 78" above finish floor and are not visible from an upper level;
d. stretchers, blocking, and/or components are concealed by drawers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including high-pressure decorative laminate adhesive for bonding plastic laminate and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.

C. Samples for Initial Selection:

1. Plastic laminates.

D. Samples for Verification:

1. Cabinets

a. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
b. Wood-grain plastic laminates, 24 by 24 inches, for each type, pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.
c. Corner pieces as follows:

1) Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.

d. Exposed cabinet hardware and accessories, one unit for each type and finish.

2. Countertops

a. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
b. Wood-grain plastic laminates, 24 by 24 inches, for each type, pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.

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 familiar with and employs AWI's Quality Certification Program Standards.

B. Installer Qualifications: Fabricator of products.

C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of one (1) typical plastic-laminate cabinet.
2. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets 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. Environmental Limitations: 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 and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are 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 cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. 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 cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS & COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Basis-of-Design: Subject to compliance with requirements, provide Architect¢s choice from full range of Formica Corporation plastic laminates or specific products by Formica indicated, or Architect¢s choice from full range of comparable products by one of the following:

    a. Lamin-Art, Inc.
    b. Wilsonart International; Div. of Premark International, Inc.

F. Laminate Cladding for Exposed Surfaces: Core- MDF

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade HGS.
3. Edges: Grade HGS.

G. Materials for Semiexposed Surfaces: Core- MDF

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
2. Drawer Sides and Backs: Solid-hardwood lumber (Maple).
3. Drawer Bottoms: Hardwood plywood (Maple veneer).

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued dovetail joints.

J. 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 woodwork and quality grade specified unless otherwise indicated.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade MD.
2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

D. Catches (Display Cabinets Only): Magnetic catches, BHMA A156.9, B03141.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.

F. Shelf Rests for Glass Shelves: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9.

1. Grade 1: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
6. For computer keyboard shelves, provide Grade 1HD-100.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 6 mm thick unless otherwise indicated.

L. Tempered Float Glass for Cabinet Shelves: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 1/2 inch thick.

M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. 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. Grommets for Cable Passage through Countertops: 2-inch , black, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide " TG series" by Doug Mockett & Company, Inc.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood 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: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

A. Interior Woodwork Grade: Unless otherwise indicated provide Custom grade interior woodwork complying with referenced quality standards Architectural Woodwork Institute(AWI).

B. Fabricate cabinets to dimensions, profiles, and details indicated.

C. 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.

1. 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 before disassembling for shipment.

D. 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.

E. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

F. Install glass to comply with applicable requirements in Section 08 8000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

G. Fabricate glass shelves with flat polished edge and eased corners.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets and countertops to average prevailing humidity conditions in installation areas. Cabinets and countertops displaying delamination and shrinking as a result of conditioning shall be removed and replaced.

B. Before installing cabinets and countertops, examine shop-fabricated work for completion and complete work as required. Check for delamination and shrinking of components among other similar characteristics or damage.

3.2 INSTALLATION

A. Grade: Install cabinets and countertops to comply with same grade as item to be installed.

B. Assemble cabinets and countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install cabinets and countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut cabinets and countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips .

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Retain first subparagraph below if applied backsplashes are used.
2. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets and countertops on exposed and semi-exposed surfaces.

END OF SECTION 06 4116

SECTION 06 6400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For plastic paneling and trim accessories.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plastic paneling and trim accessoriesfrom single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING FRP-1

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

1. Basis-of-Design Product: Subject to compliance with requirements, provide Marlite; Standard FRP, Smooth Texture.
2. Nominal Thickness: Not less than 0.09 inch.
3. Surface Finish: Smooth.
4. Color: Architect's choice from manufacturer's full range.
5. Trim and Jointing: Satin anodized aluminum.

2.2 PLASTIC SHEET PANELING FRP-2

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

1. Basis-of-Design Product: Subject to compliance with requirements, provide Marlite; Artizan FRP, Faux Woodgrains.
2. Nominal Thickness: Not less than 0.09 inch (2.3 mm).
3. Surface Finish: Textured.
4. Color: Architect's choice from manufacturer's full range of patterns.
5. Trim and Jointing: Satin anodized aluminum.

2.3 ACCESSORIES

A. Adhesive: As recommended by plastic paneling manufacturer.

B. Sealant: Single-component, mildew-resistant, acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

B. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.

1. Drill oversized fastener holes in panels and center fasteners in holes.
2. Apply sealant to fastener holes before installing fasteners.

D. Install factory-laminated panels using concealed mounting splines in panel joints.

E. Install trim accessories with adhesive. Do not fasten through panels.

F. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 6400

SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied, emulsified-asphalt dampproofing.

1.2 RELATED SECTIONS

A. Section 07 2726, Fluid-Applied Membrane Air Barrier, for weather and air barrier membranes and accessories used in cavity wall construction and other locations indicated in the Drawings.

1.3 ACTION SUBM ITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

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. APOC, Inc; a division of Gardner Industries.
2. BASF Corporation; Construction Systems.
3. Brewer Company (The).
4. ChemMasters, Inc.
5. Euclid Chemical Company (The); an RPM company.
6. Henry Company.
7. Karnak Corporation.
8. Mar-flex Waterproofing & Building Products.
9. W. R. Meadows, Inc.

B. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

2.3 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.

D. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

1. Thickness: Nominal 1/8 inch.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.

1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.

2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.

D. Where dampproofing interior face of above-grade, exterior walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations: Apply one fibered brush or spray coat at not less than 3 gal./100 sq. ft.

B. Unparged Masonry Foundation Walls: Apply primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft..

C. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft..

D. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft..

E. Exterior Face of Inner Wythe of Cavity Walls: Use Air Barrier product specified in other Division 07 Section in these locations, unless the Drawings specifically indicate the use of dampproofing. Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft.

3.3 PROTECTION COURSE INSTALLATION

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

END OF SECTION 07 1113

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation used in cavity wall, under slab, and roof construction.
2. Glass-fiber blanket insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Cavity Wall Insulation (High R-Value):

a. Basis of Design Product: Subject to compliance with requirements, provide Owens Corning Foamular 1000 Extruded Polystyrene (XPS), or comparable product by DOW Styrofoam Brand, Johns Manville, or other approved equivalent.

b. Type: XPS Extruded Polystyrene Foam board, ASTM C578 Type IV, Standard Specification for Rigid Cellular Polystyrene Thermal Insulation; planed surface, square-edged.
c. R-value: Minimum R-5 per inch of thickness per ASTM C518 @ 75 deg. F mean temperature, sq.ft.xhxdeg. F/BTU.
d. Compressive Strength: 25 PSI per ASTM D1621.
e. Water Absorption: 0.3% maximum, ASTM C272.
f. Thicknesses indicated.
g. Water Vapor Permeance: 1.5 perm max., ASTM E96.
h. Coefficient of Linear Thermal Expansion: 3.5 x10 to the negative 5th power, in/in x deg. F, ASTM D696.
i. Dimensional Stability: 2.0% linear change max., ASTM D2126.
j. Flame Spread: 15 max., ASTM E84.

k. Smoke Developed: 165 max., ASTM E84.

2. Underslab Insulation:

a. Basis of Design Product: Subject to compliance with requirements, provide Owens Corning Foamular 1000 or comparable product by DOW Styrofoam Brand, Johns Manville, or other approved equivalent.

b. Type: XPS Extruded Polystyrene Foam board, ASTM C578 Type V, Standard Specification for Rigid Cellular Polystyrene Thermal Insulation; planed surface, square-edged.
c. R-value: Minimum R-5 per inch of thickness per ASTM C518 @ 75 deg. F mean temperature, sq.ft.xhxdeg. F/BTU.
d. Compressive Strength: 100 PSI per ASTM D1621.
e. Water Absorption: 0.3% maximum, ASTM C272.
f. Thicknesses: Single layer to achieve the thicknesses indicated in the Drawings.
g. Water Vapor Permeance: 1.5 perm max., ASTM E96.

h. Coefficient of Linear Thermal Expansion: 3.5 x10 to the negative 5th power, in/in x deg. F, ASTM D696.
i. Dimensional Stability: 2.0% linear change max., ASTM D2126.
j. Flame Spread: 15 max., ASTM E84.
k. Smoke Developed: 165 max., ASTM E84.

B. Polyisocyanurate Board Insulation: ASTM C1289; of Type, Grade, and Class indicated for each application.

1. Bottom Layer Roof Insulation:

a. Closed-cell Polyisocyanurate rigid cellular insulation with glass-fiber-reinforced facers on both sides; ASTM C1289, Type II, Class 3, Grade 2. Approved for Class 1 insulated steel deck constructions for 1-60 to 1-270.
b. R-value: Minimum R-5.8 per inch of thickness per ASTM C518 @ 75 deg. F mean temperature, sq.ft.xhxdeg. F/BTU.
c. Thickness: As indicated, but of thickness necessary to achieve minimum R value indicated for the total insulation system.
d. Compressive Strength: 20 psi min.
e. Subject to compliance with requirements, available roof insulation manufacturers include, but are not limited to, the following:

1) Carlisle SynTec.
2) Hunter Panels.
3) Johns Manville.
4) RMax.

2. Top Layer Insulation:

a. Closed-cell Polyisocyanurate rigid cellular insulation with integrally-bonded ½ inch high-density polyisocyanurate board top face, and glass-fiber-reinforced facer on bottom; ASTM C1289, Type IV. Approved for Class 1 insulated steel deck constructions for 1-60 to 1-270.
b. R-value: Minimum R-5.8 per inch of thickness per ASTM C518 @ 75 deg. F mean temperature, sq.ft.xhxdeg. F/BTU.
c. Compressive Strength: 16 psi min.
d. Basis-of-Design: Subject to compliance with requirements, provide Hunter Panels – H-Shield HD Composite CG panels, or comparable product by another manufacturer including, but not limited to, the following:

1) Carlisle SynTec.
2) Iko.
3) Johns Manville.
4) RMax.

C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

D. Fasteners for Attaching Insulation: Corrosion-resistant, self-drilling steel screws of type and length recommended by roof insulation manufacturer and as required by FM Global to exceed wind uplift requirements for the roof slope, exposure, and insulation thicknesses. Provide washers or bearing plates if recommended.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Johns Manville.
3. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

D. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

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. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation with units abutting according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units. Do not overlap panels.

1. Under slab locations:

a. Do not place insulation until just prior to placement of concrete, to limit damage to insulation due to construction traffic. Close area to all construction activities until placement of concrete.
b. Prepare, grade, and compact subgrade to allow full contact of insulation and subgrade without deforming the insulation.
c. Completely fill areas with insulation in one uniform layer, neatly cutting and coping insulation units to abutting construction and penetrating items.
d. During insulation placement, verify there are no voids, hollows, or humps / peaks beneath every insulation panel. Remedy every such inconsistency by re-grading, or adding or removing subgrade material and compacting.
e. Do not damage or dislodge other in-slab or under-slab items during insulation placement, such as vapor retarder membrane or reinforcement.
f. Place concrete in a slow and controlled manner that does not shift or dislodge insulation units, and that does not damage insulation.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

3.5 INSTALLATION OF ROOF INSULATION

A. Prior to installation of insulations, continuously seal all metal deck joints, edges, perimeter at abutting construction, and penetrations with appropriate exterior elastomeric sealant or mastic and joint fillers if necessary to create a continuous air barrier plane.

B. Prior to installing insulation, install exterior rated, fire-retardant-treated 2x lumber insulation stops as recommended by the insulation manufacturer at all roof deck penetrations, openings, eaves, and edges. Insulation stops shall be the same depth as the insulation thickness.

C. Use two staggered layers of insulation to achieve the indicated total insulation thickness.

1. Install insulation with long edges of boards either parallel to or perpendicular to roof eave, as specifically recommended by roof insulation manufacturer for the roof slope and the indicated attachment system.

a. Begin installation at roof eaves, and work in successive rows up the roof slope.
b. For the bottom layer, stagger roof insulation boards in each successive row ½ the width of the boards.
c. For the top layer, use identical pattern as bottom layer, but stagger the panel joints approximately 6 inches horizontally and vertically from the layer below, and as specifically recommended by the insulation manufacturer.
d. Neatly and uniformly miter, cope, and cut insulations at joints, penetrations, and abutting construction to avoid gaps and voids in insulation, with edge clearances recommended by manufacturer for each condition.

2. Adhere and mechanically fasten each insulation layer.

a. Bottom layer: Apply full-coverage ribbons of adhesive specifically recommended by the manufacturer to the flutes of the metal roof deck before placing each insulation board; periodically lift and check adhesive coverage to ensure full contact with insulation boards, and adjust application rate if required to achieve full contact. Install corrosion-resistant mechanical fasteners through boards and into roof deck.
b. Top layer: Apply ribbons or spots of adhesive to bottom layer of insulation of type and pattern specifically recommended by the roof insulation manufacturer before placing each insulation board; periodically lift and check adhesive coverage, and adjust application rate if required to achieve manufacturer's contact and coverage requirements. Install corrosion-resistant mechanical fasteners through boards and into roof deck.
c. Fasteners shall be corrosion resistant, full-depth, and shall be of type, length, and fastening pattern as specifically recommended by roof insulation manufacturer, and as required by FM Global to exceed the wind uplift requirements. Use fastening plates or washers if recommended by manufacturer or FM Global.

D. Follow specific additional installation requirements for standing seam metal roofing as they affect roof insulation requirements and procedures.

E. Protect installed insulations from foot traffic and construction damage, and from exposure to rain and snow. Remove and replace all insulation that has been damaged, or has been wetted for more than 24 hours.

3.6 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber 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 clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. 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, 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 C 1320 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.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward interior of construction.
    b. Interior Walls: Set units with facing placed toward areas of high humidity only, otherwise no facing shall be placed on interior wall insulation.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation of exterior insulated envelope using the following materials:

1. FSK Glass Fiber Blanket Insulation

3.7 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100

SECTION 07 2600 - VAPOR RETARDERS

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. Reinforced-polyethylene vapor retarders for installation beneath concrete slabs on grade.

B. Related Requirements:

1. Section 03 3000 "Cast-in-Place Concrete" for associated concrete slabs.
2. Section 07 2100 "Thermal Insulation" for vapor retarders integral with insulation products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 REINFORCED-POLYETHYLENE VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 20 lb/1000 sq. ft. 70 lbs per 1,000 Sq ft. .

1. Water Vapor Permeance: No greater than 0.009 perms, per ASTM F 1249.
2. Membrane Class: Class A, per ASTM E 1745, Standard Specification for Plastic Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

3. Puncture Resistance: No less than 2,260 grams, per ASTM D 1709 Test Method for Impact Resistance of Plastic Film by Free-Falling Dart Method.
4. Tensile Strength: Not less than 70 lbf/in, per ASTM D 882.
5. Thickness: Not less than 15 mils.
6. Composition: Multi-layer plastic extrusion manufactured with only high grade prime, virgin polyolefin resins.
7. Basis-of-Design Product: Subject to compliance with requirements, provide Stego Industries; Stego Wrap 15-Mil Vapor Barrier or comparable product by one of the following:

    a. Insulation Solutions, Inc.
    b. Raven Industries Inc.
    c. Reef Industries, Inc.

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS UNDER CONCRETE SLABS

A. Install vapor retarders over screeded, prepared subgrade, continuously beneath all interior concrete slabs on grade. Install vapor retarder just prior to concrete placement and close areas to all construction activities after installation to prevent damage to membrane.

B. Lap all seams no less than 6 inches, and seal seams with manufacturer's recommended tape.

C. Extend vapor retarder membrane no less than 6 inches up abutting walls.

D. Tightly cope and positively seal membrane to all penetrating items using manufacturer's recommended tapes, adhesive, and accessories.

E. Inspect continuity and condition of installed vapor retarder just prior to placement of concrete, and repair all defects per manufacturer's recommendations.

3.3 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 2600

SECTION 07 2726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vapor-permeable, fluid-applied air barriers.

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 air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated in other Sections within this specification, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

    a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.

PART 2 - PRODUCTS

2.1 MATERIALS

A. VOC Content: 100 g/L or less.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 17 to 30 mils over smooth, void-free substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. DuPont Building Innovations: E. I. du Pont de Nemours and Company; DuPont Tyvek Fluid Applied WB.
    b. W.R. Meadows, Inc; Air-Shield LMP.
    c. Hohmann & Barnard Inc; Enviro-Barrier VP.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Vapor Permeance: Minimum 10 perms; ASTM E 96/E 96M, Desiccant Method, Procedure A.
c. Ultimate Elongation: Minimum 400 percent; ASTM D 412, Die C.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. hen tested according to ASTM D 4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 120 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.2 INSTALLATION

A. Contractor shall have their choice of providing either high build or medium build products at their discretion unless one or the other is specifically indicated to be applied within a specific location.

B. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

E. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

F. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

G. Do not cover air barrier until it has been tested and inspected by testing agency.

H. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Remove masking materials after installation.

END OF SECTION 07 2726

SECTION 07 4113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

B. Related Sections:

1. Section 07 4293 "Soffit Panels" for metal panels used in horizontal soffit applications.
2. Section 07 7253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

1.3 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 methods and procedures related to metal panel installation, including manufacturer's written instructions.
3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
4. Review structural loading limitations of deck during and after roofing.
5. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel systems during and after installation.
8. Review procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. 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.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for typical roof area only, including accessories.

a. Size: 12 feet long by 6 feet.
b. Each type of exposed seam and seam termination.

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. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 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. Failures include, but are not limited to, the following:

    a. Structural failures including rupturing, cracking, or puncturing.
    b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    b. Chalking in excess of a No. 8 rating when tested according to 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.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

C. 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, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels : Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design: Subject to compliance with requriements, provide Pac-Clad; Tite-Loc Plus Panels, or comparable product by one of the following:

a. AEP Span; A BlueScope Steel Company.
b. Architectural Metal Systems.
c. ATAS International, Inc.
d. Berridge Manufacturing Company.
e. CENTRIA Architectural Systems.
f. Englert, Inc.
g. Fabral.
h. Firestone Metal Products, LLC.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.034 inch.
b. Exterior Finish: Two-coat fluoropolymer .
c. Color: As selected by Architect from manufacturer's full range.

3. Clips: Two-piece floating to accommodate thermal movement.

a. Material: 0.028-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

4. Joint Type: Double folded.
5. Panel Coverage: 18 inches .
6. Panel Height: 2.0 inches.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Carlisle Residential; a division of Carlisle Construction Materials; WIP 300HT.
    b. Grace Construction Products; W.R. Grace & Co. -- Conn.; Grace Ice and Water Shield HT.
    c. Henry Company; Blueskin PE200 HT.
    d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
    e. Metal-Fab Manufacturing, LLC; MetShield.
    f. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 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, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- 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. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch- thick, rigid insulation.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads.

F. Panel Sealants: Provide sealant type 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. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 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. 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.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. 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.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. 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: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 6200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.

6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

F. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

I. Roof Curbs: Install flashing around bases where they meet metal roof panels.

J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

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.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4113.16

SECTION 07 4213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.

B. Related Sections:

1. Section 07 4213.19 "Insulated Metal Wall Panels" for foamed-in-place, laminated and honeycomb insulated metal wall panels.
2. Section 07 4293 "Soffit Panels" for metal panels used in horizontal soffit applications.

1.3 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 methods and procedures related to metal panel installation, including manufacturer's written instructions.
3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
4. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
5. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
6. Review temporary protection requirements for metal panel assembly during and after installation.
7. Review of procedures for repair of metal panels damaged after installation.
8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. 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.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly roughly 10 by 10 feet, including corner, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.

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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 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. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to 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. 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. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

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: 2.86 lbf/sq. ft..

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, ambient; 180 deg F, material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Batten-Rib Profile, Concealed Fastener Metal Wall Panels: Formed with raised, trapezodal ribs covering panel joints, with smooth pans between ribs.

1. Basis-of-Design: Subject to compliance with requirements, provide ATAS International; Multi-Purpose Panels MPW, or comparable product by one of the following:

   a. Alcoa Architectural Products (USA).
   b. Morin - A Kingspan Group Company.
   c. PAC-CLAD; Petersen Aluminum Corporation.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

   a. Nominal Thickness: 0.034 inch.
   b. Exterior Finish: Two-coat fluoropolymer .

3. Color: As selected by Architect from manufacturer's full range.
4. Panel Texture: Smooth.
5. Panel Coverage: 12 inches.
6. Panel Length: Up to 20 feet maximum.
7. Panel Depth: 1 1/4" at trapezoidal battens.
8. Batten Profile: Trapezoidal section, with 1 1/4 inch wide flat face.

2.3 MISCELLANEOUS MATERIALS

A. Composite Subframing and Furring: Composite Metal Hybrid (CMH) thermally broken cladding and insulation engineered sub-framing attachment system.

1. Basis of Design Product: Subject to compliance with requirements, provide GreenGirt Simple Z Sub-framing as manufactured by Advanced Architectural Products or comparable product by another manufacturer.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- 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. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal 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 type 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. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and 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. 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.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. 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: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 INSTALLATION

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. 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.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

3.4 CLEANING AND PROTECTION

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.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4213.13

SECTION 07 4213.19 - INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Foamed-insulation-core metal wall panels.

1.3 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 methods and procedures related to metal panel installation, including manufacturer's written instructions.
3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
4. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
5. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
6. Review temporary protection requirements for metal panel assembly during and after installation.
7. Review procedures for repair of metal panels damaged after installation.
8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. 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.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches .

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly no less than 10 by 10 feet, including corner, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 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. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 72:

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 0.01 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test Pressure Difference: 20 psf.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Static Test Pressure Difference: 20 psf.

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, ambient; 180 deg F, material surfaces.

E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
2. Potential Heat: Acceptable level when tested according to NFPA 259.

3. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.
c. Compressive Strength: Minimum 20 psi when tested according to ASTM D 1621.
d. Shear Strength: 26 psi when tested according to ASTM C 273/C 273M.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels : Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Metl-Span; CF Mesa Insulated Metal Wall Panels or comparable product by one of the following:

a. CENTRIA Architectural Systems.
b. Insulated Panel Systems (IPS).
c. Kingspan Insulated Panels.
d. MBCI; a division of NCI Group, Inc.

2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Nominal Thickness: 0.034 inch .
b. Texture: Smooth.
c. Panel Profile: Longitudinal plank profile, consisting of alternating 4 inch wide by 1/8 inch deep raised and depressed ribs.
d. Exterior Finish: Two-coat fluoropolymer .

1) Color: As selected by Architect from manufacturer's full range.

e. Interior Finish: Siliconized polyester.

1) Color: As selected by Architect from manufacturer's full range.

3. Panel Coverage: 36 inches nominal.
4. Panel Thickness: 2.0 inches .
5. Thermal-Resistance Value (R-Value): Not less than 14 for a 42 inch wide panel according to ASTM C 1363.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 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, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- 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. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners only where absolutely necessary, 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 type 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. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

A. General: 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.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 INSULATED METAL WALL PANEL INSTALLATION

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
4. 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.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Metal wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

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.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4213.19

SECTION 07 4293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal soffit panels.

B. Related Sections:

1. Section 07 4213.19 "Insulated Metal Wall Panels" for lap-seam metal wall panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof eave and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 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. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 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. 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, ambient; 180 deg F, material surfaces.

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. V-Groove-Profile Metal Soffit Panels : Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with a V-groove joint between panels.

1. Basis-of-Design: Subject to compliance with requriements, provide Pac-Clad, Petersen Aluminum Corporation; PAC-750 Soffit, Half-Vent, or comparable product by one of the following:

    a. ATAS International, Inc.
    b. Berridge Manufacturing Company.
    c. Englert, Inc.
    d. Fabral.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch.
    b. Surface: Smooth, flat finish.
    c. Exterior Finish: Two-coat fluoropolymer .
    d. Color: As selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches.
4. Panel Height: 0.50 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 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.

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. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and 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. 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.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 INSTALLATION

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal 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.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

F. 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.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

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.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4293

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed wall sheet metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.5 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows 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. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; 2D (dull, cold rolled) finish.

C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designationor aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 ; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: As selected by Architect from manufacturer's full range.

2.3 UNDERLAYMENT MATERIALS

A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

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. Carlisle Coatings & Waterproofing Inc; CCW WIP 300HT.
b. Grace Construction Products; W.R. Grace & Co. -- Conn.; Grace Ice and Water Shield HT.
c. Henry Company; Blueskin PE200 HT.
d. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Not permitted.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED REGLETS

A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

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. Cheney Flashing Company.
b. Fry Reglet Corporation.
c. Heckmann Building Products, Inc.
d. Hickman Company, W. P.
e. Hohmann & Barnard, Inc.
f. Keystone Flashing Company, Inc.
g. National Sheet Metal Systems, Inc.

h. Sandell Manufacturing Co., Inc.

2. Material: Stainless steel, 0.019 inch thick .
3. Finish: Mill With manufacturer's standard color coating Manufacturer's standard color coating for all visible components; and mill finish where not visible.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.7 WALL SHEET METAL FABRICATIONS

A. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches . Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
   4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
   5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
   1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feetwith no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches ; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 07 6200

SECTION 07 7200 - ROOF 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. Roof curbs.
2. Equipment supports.
3. Preformed flashing sleeves.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 07 6200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
3. Section 07 7253 "Snow Guards" for snow guards.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

D. Delegated-Design Submittal: For roof curbs equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 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 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 according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: As indicated on Drawings.

2.2 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, and integrally formed deck-mounting flange at perimeter bottom.

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. Adaptable Air Products.
b. AES Industries, Inc.
c. Air Balance; a division of MESTEK, Inc.
d. Conn-Fab Sales, Inc.
e. Curbs Plus, Inc.
f. Custom Solution Roof and Metal Products.
g. Greenheck Fan Corporation.
h. KCC International Inc.
i. Kingspan Light + Air, North America.
j. Lloyd Industries, Inc.
k. LMCurbs.
l. Louvers & Dampers, Inc.; a division of Mestek, Inc.
m. Metallic Products Corp.
n. Milcor; Commercial Products Group of Hart & Cooley, Inc.

o. Pate Company (The).
p. Plenums Incorporated.
q. Roof Curb Systems.
r. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
s. Roof Products, Inc.
t. Sunoptics.
u. Thybar Corporation.
v. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Material: Stainless steel sheet, 0.0781 inch Insert dimension thick.

1. Finish: Manufacturer's standard ASTM A480/A480M, No. 2D, directional polish finish Insert finish.

E. Construction:

1. Curb Profile: Profile as indicated on Drawings compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
9. 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.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, and integrally formed structure-mounting flange at bottom.

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. Adaptable Air Products.
b. AES Industries, Inc.
c. Air Balance; a division of MESTEK, Inc.
d. Conn-Fab Sales, Inc.
e. Curbs Plus, Inc.
f. Custom Solution Roof and Metal Products.
g. Greenheck Fan Corporation.
h. KCC International Inc.
i. Lloyd Industries, Inc.
j. LMCurbs.
k. Louvers & Dampers, Inc.; a division of Mestek, Inc.
l. Milcor; Commercial Products Group of Hart & Cooley, Inc.
m. Pate Company (The).
n. Plenums Incorporated.
o. Roof Curb Systems.
p. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
q. Roof Products, Inc.
r. Thybar Corporation.
s. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Material: Stainless steel sheet, 0.0781 inch thick.

1. Finish: Manufacturer's standard.

E. Construction:

1. Curb Profile: Profile as indicated on Drawings compatible with roofing system.

2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
3. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide on top flange of equipment supports, continuous around support perimeter.
4. 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.
5. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
6. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
7. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
8. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.4 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted perforated metal collar.

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. Custom Solution Roof and Metal Products.
    b. Menzies Metal Products.
    c. Thaler Metal Industries Ltd.

2. Metal: Aluminum sheet, 0.063 inch thick.
3. Diameter: As indicated on Drawings.
4. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

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. Custom Solution Roof and Metal Products.
    b. Menzies Metal Products.
    c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    d. Thaler Metal Industries Ltd.

2. Metal: Aluminum sheet, 0.063 inch thick.

3. Height: 13 inches.
4. Diameter: As indicated on Drawings.
5. Finish: Manufacturer's standard.

2.5 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 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. 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.

B. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. 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.

2. 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.

C. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

D. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

E. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

F. Steel Tube: ASTM A500/A500M, round tube.

G. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

H. Steel Pipe: ASTM A53/A53M, galvanized.

2.6 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., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

C. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

D. 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 AWPA C2; not less than 1-1/2 inches thick.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

F. Underlayment:

1. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
2. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils 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.

G. 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:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

H. 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.

I. Elastomeric Sealant: ASTM C920, elastomeric silicone 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.

J. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

K. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. 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] [stainless steel] 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.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

F. Seal joints with elastomeric butyl sealant as required by roof accessory manufacturer.

3.3 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 09 9113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7200

SECTION 07 7253 - SNOW GUARDS

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. Rail-type, seam-mounted snow guards.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.
2. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish.

C. Samples: Base, bracket, and 12-inch- long rail.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of snow guard, for tests performed by manufacturer and witnessed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Structural Performance:

1. Snow Loads: As indicated on Drawings.

2.2 RAIL-TYPE SNOW GUARDS

A. Seam-Mounted, Rail-Type Snow Guards:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Petersen Aluminum; Pac-Clad Colorgard Snow Retention System or comparable product by one of the following:

a. Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.
b. LMCurbs.
c. Metal Roof Innovations, Ltd.; S-5! Attachment Solutions.
d. Snow Management Systems; a division of Contek, Inc.
e. TRA-MAGE, Inc.

2. Description: Snow guard rails fabricated from extruded aluminum, anchored to brackets and equipped with one rail with color-matching insert of material used for metal roofing.
3. Material and Finish: Aluminum; mill, with slide-in strip of manufacturer's standard color, matched to roof color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer.

B. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.
2. Seam-Mounted, Rail-Type Snow Guards: Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

END OF SECTION 07 7253

SECTION 07 8413 - PENETRATION FIRESTOPPING

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 describes firestopping materials and procedures:

1. Penetrations through fire-resistance-rated construction, including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrations.
2. Expansion and control joints in fire-rated walls, floors, floor-ceiling and roof/ceiling assemblies.
3. Voids at the intersections of fire-rated walls, floors, floor-ceilings,and roof/ceiling assemblies.
4. Intersections and penetrations of floors, ceilings, walls, and columns.
5. Penetrations in fire-resistance-rated walls.

1.3 REFERENCES

A. The following publications govern the work of this Section and are hereby incorporated in the Contract Documents as if bound herein. The Standards described apply generally unless specifically indicated otherwise inthe text. They are identified below by thier publishers and ae referred to in the text by basic designation only.

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

a. ASTM E 84-91a Surface Burning Characteristics of Building Materials
b. ASTM C 1193-91 Guide for Use of Joint Sealants
c. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2012
d. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems
e. ASTM E1966 - Standard test method for Fire Resistive Joint Systems; 2007 (Reapproved 2011.)
f. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multistory Test Apparatus; 2010
g. ASTM E2837 - Standard Test Method for Determining Fire Resistance of Continuity Head of Wall joint Systems Installed Between rated Wall Assemblies and Non-rated Horizontal Assemblies; 2011

h. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymer Materials to Fungi; 2009

2. UNDERWRITERS LABRATORIES (UL)

a. UL-05 Fire Resistance Directory
b. UL 723 Test for Surface Burning Characteristics of Building Materials
c. UL 1479 Fire Tests of Through Penetration Firestops
d. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; 2004

3. OTHER TESTING SERVICES AND AGENCIES

a. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
b. FM 4991 - Approval of Firestop Contractors; Factory mututal Research Corporation; 2001
c. FM P7825 - Approval Guide; Factory Mututal Research Corporation; current edition.
d. SCAQMD 1168 - South Coast Air Quality Management District Rule No. 1168; current edition; www.aqmd.gov.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's descriptive data, installation instructions, and the fire-test data and/or report as appropriate for the fire resistance rated construction and location. Submittal shall indicate the firestopping material to be provided with each type of application.

B. Shop Drawings: Show illustration details as appropriate for the fire resistance rated construction and locations required. When more than 5 penetrations are to receive firestopping , drawings shall indicate location and type of application.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates: Certificates attesting that firestopping material complies with the specific requirements. The label or listing of the Underwriters Laboratories will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing agency equipped to perform such services, stating that the items have been tested and conform to the specified requirements and testing.

B. Installer Qulaifications: Manufacturers certification stating that each installer is qualified and trained to install the specified requirements and testing.

C. Manufacturer's installation instructions: indicate preparation and installation instructions.

D. Manufacturer's Certificate: Certify tht products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.7 SYSTEM DESCRIPTION

A. Firestopping shall consist of furnishing and installing a material or combination of materials to form an effective barrier against the spread of flame, smoke, and gases, and maintain the integrity of fire resistance rate walls, barriers, partitions, floors, floor/ceiling/roof assemblies, including through penetrations and construction joints. Through-penetrations include the annular spaces around pipes, tubes, conduits, wires, cables, and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping materials shall not interfere with required movement of joints.

1.8 STORAGE AND DELIVERY

A. Materials shall be delivered in the original un-opened packages or containers showing names of the manufacturer and the brand name of the product. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.9 PROJECT CONDITIONS

A. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

PART 2 - PRODUCTS

2.1 FIRESTOPPING MATERIALS, GENERAL

A. Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:

1. Fire Hazard Classification: Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Materials shall be non-toxic to humans at all stages of the application and performance of the materials.
2. Fire Resistance Rating: Firestopping will not be required to have a greater fire reistance rating than that of the assembly in which it is being installed within. Fire resistance ratings of construction joints, as desscribed in Part 1 Article "System Description" and gaps such as the construction in which they occur.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grace Construction Products.
2. Hilti, Inc.
3. RectorSeal Corporation.
4. Specified Technologies Inc.
5. 3M Fire Protection Products.
6. Tremco, Inc.; Tremco Fire Protection Systems Group.
7. USG Corporation.

2.3 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Fire-resistance-rated walls include fire walls fire-barrier wallssmoke-barrier walls and fire partitions.

2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

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 manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:

a. Slag-wool-fiber or rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.4 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

1. Cast-In-Place Firestop Device for non-combustible and combustible pipes, conduits, and cable bundles penetrating concrete floors:

a. Basis-of-Design Product: CP68ON Cast-in-Place Firestop Device as manufactured by Hilti, Inc. or comparable product by one of the following:

1) Johns Mansville
2) Nelson Firestop Products
3) Specified Technologies Inc.
4) 3M Fire Protection Product Division

B. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

C. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

D. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

E. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

F. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.5 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Comply with System Performance Rquirements Article in Part 1, with ASTM C 1193 and with the sealant manufacturer's installation instructions and drawings pertainng to products and applications indicated.

B. 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 indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
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.

D. Firestopping materials shall completely fill void spaces regardless of geometric configuration, subject to tolerances established by the manufacturer. Firestopping for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the flooris designed to supportor shall be protected by permanent barrier to prevent loading of traffic in the firestopped area. Firestopping shall be provided in the following locations:

1. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, barriers, partitions, floors, ceilings, and roof assemblies.
2. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
3. Gaps at the intersection of floor and curtain walls, including inside of hollow curtain walls at the floor slab.
4. Construction joints in floors and fire rated walls and partitions.
5. Gaps at perimeter of fire resistance rated walls, barriers, and partitions, such as between the top of walls and the bottom of roof decks.
6. Other locations where required to maintain fire resistance rated construction.

E. Penetrations made in existing building walls shall be sealed and firestopped the same day they are made. Existing holes within existing building walls abutting new construction or within areas of new construction uncovered or created by demolition procedures shall be sealed and firestopped.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. 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."

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 8413

SECTION 07 9100 - PREFORMED JOINT SEALS

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. Preformed, foam joint seals.

1.3 ACTION SUBMITTALS

A. Product Data: For each preformed joint seal product.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of preformed joint seal required, provide Samples with joint seals in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint seals.

D. Preformed Joint Seal Schedule: Include the following information:

1. Joint seal location and designation.
2. Joint width and movement capability.
3. Joint seal manufacturer and product name.
4. Joint seal color.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each preformed joint seal for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Mockups: Install mockups of assemblies specified in other Sections that are indicated to receive preformed joint seals specified in this Section. Use materials and installation methods specified in this Section.

1.6 WARRANTY

A. Special Warranty: Installer agrees to repair or replace preformed joint seals that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PREFORMED, FOAM JOINT SEALS

A. Preformed, Foam Joint Seals : Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft., faced with a colored, pre-formed silicone or polysulfide bellows-shaped outer facing, and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. LymTal International, Inc.; Iso-Flex Precom C.
b. MM Systems Corporation; EIS.
c. Schul International Company, Inc.; Color Econoseal Seismic Sealtite 61CR.
d. Watson Bowman Acme Corporation; Wabo SeismicWeatherSeal.

2. Design Criteria:

a. Nominal Joint Width: As indicated on Drawings.
b. Minimum Joint Width: As indicated on Drawings.
c. Maximum Joint Width: As indicated on Drawings.

d. Movement Capability: -25 percent/+25 percent.

3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by preformed-joint-seal manufacturer for joint substrates indicated.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed-joint seal performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal 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 optimal bond with preformed joint seals. 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.

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 seals. Nonporous joint substrates include the following:

a. Metal.
b. Glass.

B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Installation of Preformed, Foam Joint Seals:

1. Install each length of seal immediately after removing protective wrapping.
2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

3.4 PROTECTION

A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals 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 seals immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 9100

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior joints in vertical surfaces ans non-traffic horizontal surfaces as indicated below:

    a. Control and expansion joints in unit masonry.
    b. Joints between materials
    c. Perimeter joints between materials and frames of doors and windows.
    d. Other joints as indicated.

2. Exterior joints in horizontal traffic surfaces as indicated below:

    a. Control, expansion and isolation joints in cast-in-place concrete slabs.
    b. Joints between different materials
    c. Other joints as indicated

3. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:

    a. Control, expansion joints on exposed interior surfaces of exterior walls
    b. Perimeter joints of exterior openings where indicated.
    c. Joints between tops of non-load bearing unit masonry and concrete walls and partitions.
    d. Tile control and expansion joints
    e. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
    f. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

1.3 DEFINITIONS

1. Joint Sealants- caulk, caulking or joint sealers are synonomous and mean joint sealants as herein described.

2. Exterior- joints at exterior surfaces of the building, whether or not directly exposed to the weather.
3. Interior- joints at interior surfaces of the building but not exposed to the weather in any manner.
4. Paving- Joints in floor slabs, sidewalks, steps, ramps, and curbs.

B. SYSTEM PERFORMANCE REQUIREMENTS

1. Provide elastomeric joint sealants that have been produced and installed to establish and maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.
2. Provide joint sealants for interior applications that have been produced ans installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

    a. Perform tests under environmental conditions replicating those that will exist during installation.

2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:

    a. Each kind of sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.5 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

1. Certification by joint sealant manufacturer that sealants manufacturer that sealants plus primers and cleaners required for sealant installation comply with local regulations controlling use of volatile organic compounds.
2. Certificates from the manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for use indicated.

B. Material Safety Data Sheets: indicating that the VOC levels of the products provided under this Section do not exceed the specified allowable levels.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion Test Reports: For each sealant application tested.

G. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.8 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural 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 MATERIALS, 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: Joint sealant colors shall be chosen by Architect from manufacturer's full range of colors. Multiple sealant colors may be chosen by Architect to achieve aesthetic value. Vertical or horizontal joints may consist of multiple sealant colors transitioning at differing materials.

C. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 795.
b. GE Advanced Materials - Silicones; UltraPruf II SCS2900.
c. Pecora Corporation; 895.

B. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 790.
b. May National Associates, Inc.; Bondaflex Sil 728 NS.
c. Pecora Corporation; 311 NS.
d. Tremco Incorporated; Spectrem 800.

C. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 786 Mildew Resistant.
b. GE Advanced Materials - Silicones; Sanitary SCS1700.
c. Tremco Incorporated; Tremsil 200 Sanitary.

2.3 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Building Systems; Sonolac.
b. Pecora Corporation; AC-20+.
c. Tremco Incorporated; Tremflex 834.

2.4 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; AC-20 FTR.
b. USG Corporation; SHEETROCK Acoustical Sealant.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) 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.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions 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. Remove laitance and form-release agents from concrete.
3. 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.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Latex Sealant Installation Standard: Comply with requirements of ASTM C 290 for use of latex sealants.

D. Install sealant backings of kind 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.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to 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 per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, 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 recommendations.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Control and expansion joints in brick pavers.
b. Isolation and contraction joints in cast-in-place concrete slabs.
c. Joints between plant-precast architectural concrete paving units.
d. Joints in stone paving units, including steps.
e. Tile control and expansion joints.
f. Joints between different materials listed above.
g. Other joints as indicated.

2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Joints between plant-precast architectural concrete units.
c. Control and expansion joints in unit masonry.
d. Joints in dimension stone cladding.
e. Joints in exterior insulation and finish systems.
f. Joints between metal panels.
g. Joints between different materials listed above.
h. Perimeter joints between materials listed above and frames of doors windows and louvers.

i. Control and expansion joints in ceilings and otheroverhead surfaces.
j. Other joints as indicated.

2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Vertical joints on exposed surfaces of interior unit masonryconcrete walls and partitions.
d. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
e. Other joints as indicated.

2. Joint Sealant: Acrylic Latex or Siliconized Acrylic Latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated.

2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Location:

a. Control and expansion joints on exposed interior surfaces of walls receiving acoustic sensitive materials/construction.
b. Perimeter joints between interior wall surfaces and frames of interior doors windows.
c. Perimeter joints of walls and partitions between at ceilings and floors.

d. Acoustical joints where indicated.

2. Joint Sealant: Acoustical.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 9200

SECTION 07 9513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior expansion joint cover assemblies.

B. Related Sections:

1. 07 4113.16 ÓStanding Seam Metal Roof Panels• for sheet metal closures and trim used for concealing expansion joints in standing seam roof assemblies.
2. 07 4213.19 ÓInsulated Metal Wall Panels• for sheet metal closures and trim used for concealing expansion joints in exterior walls.
3. 07 9100 ÓPreformed Joint Seals• for elastomeric joint seals used in exterior wall expansion joints concealed behind metal wall panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each expansion joint cover assembly.

C. Samples: For each expansion joint cover assembly and for each color and texture specified.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

C. Expansion Joint Design Criteria:

1. Type of Movement: Thermal.

a. Nominal Joint Width: 2 inches.

2.3 FLOOR EXPANSION JOINT COVERS

A. Center-Plate Floor Joint Cover for Slab-to-Slab Joints: Assembly consisting of center plate that slides over metal frames fixed to sides of joint gaps.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties; ALR-200 Series or comparable product by one of the following:

a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
b. Balco, Inc.
c. InPro Corporation (IPC).
d. MM Systems Corporation.
e. Nystrom, Inc.
f. Watson Bowman Acme Corp.

2. Application: Floor to floor.
3. Installation: Recessed.
4. Load Capacity:

a. Concentrated Load: 500 lb.

5. Cover-Plate Design: Plain.
6. Exposed Metal: Aluminum, Mill.

B. Surface Mount Saddle Type Cover for Floor-to-Floor Joints: One-piece assembly consisting of mill-finish flat-stock aluminum plate with beveled edges and serrated walking surface, with fastener holes along one edge for fastening to substrate on only one side of joint.

1. Basis-of-Design: Subject to compliance with requirements, provide InPro Corporation (IPC); 808 Series Standard Cover Plate System A01 Floor/Floor, or comparable product by one of the following:

a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.

b. Balco, Inc.
c. Construction Specialties.
d. MM Systems Corporation.
e. Nystrom, Inc.
f. Watson Bowman Acme Corp.

2. Application: Floor to wall.
3. Installation: Surface mounted.
4. Width: As indicated in the Drawings, but not less than the width of the joint plus 4 inches (providing equal 2 inch lap on both sides of joint).
5. Load Capacity:

a. Concentrated Load: 500 lb.

6. Cover-Plate Design: Beveled edges, and serrated top walking surface, with countersunk fastener holes.
7. Exposed Metal: Aluminum, Mill.

C. Center-Plate Floor Joint Cover for Slab-to-Wall Joints: Assembly consisting of center plate that slides over metal frames fixed to sides of joint gaps.

1. Basis-of-Design: Subject to compliance with requirements, provide Construction Specialties; ALRW-200 Series or comparable product by one of the following:

a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
b. Balco, Inc.
c. InPro Corporation (IPC).
d. MM Systems Corporation.
e. Nystrom, Inc.
f. Watson Bowman Acme Corp.

2. Application: Floor to wall.
3. Installation: Recessed.
4. Load Capacity:

a. Concentrated Load: 500 lb.

5. Cover-Plate Design: Plain.
6. Exposed Metal: Aluminum, Mill.

2.4 WALL EXPANSION JOINT COVERS

A. Elastomeric-Seal Wall Joint Cover For Gypsum Wallboard-to-Gypsum Wallboard Joints: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
2. Balco, Inc.

3. InPro Corporation (IPC).
4. MM Systems Corporation.
5. Nystrom, Inc.
6. Watson Bowman Acme Corp.

7. Application: Wall to wall.
8. Fire-Resistance Rating: Not less than that of adjacent construction.
9. Exposed Metal:

    a. Aluminum: Mill.

10. Seal: Preformed elastomeric membranes or extrusions.

    a. Color: As selected by Architect from manufacturer's full range.

B. Elastomeric-Seal Wall Joint Cover For Gypsum Wallboard Inside-Corner Joints (Wall-to Wall or Wall-to-Ceiling): Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties; FWFC-200 Series or comparable product by one of the following:

    a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
    b. Balco, Inc.
    c. InPro Corporation (IPC).
    d. MM Systems Corporation.
    e. Nystrom, Inc.
    f. Watson Bowman Acme Corp.

2. Application: Inside corner joints, either wall-to-wall, or wall-to-ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal:

    a. Aluminum: Mill.

5. Seal: Preformed elastomeric membranes or extrusions.
6. Color: As selected by Architect from manufacturer's full range.

C. Elastomeric-Seal Wall Joint Cover For Masonry Walls, and Masonry to Other Construction: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties; FWF-M-200 Series or comparable product by one of the following:

    a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
    b. Balco, Inc.
    c. InPro Corporation (IPC).
    d. MM Systems Corporation.

e. Nystrom, Inc.
f. Watson Bowman Acme Corp.

2. Application: Wall to wall.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal:

a. Aluminum: Mill.

5. Seal: Preformed elastomeric membranes or extrusions.
6. Color: As selected by Architect from manufacturer's full range.

2.5 CEILING EXPANSION JOINT COVERS

A. Elastomeric-Seal Ceiling Joint Cover For Acoustical Ceiling Joints: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Speciallties; FCF-200 Series or comparable product by one of the following:

a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
b. Balco, Inc.
c. InPro Corporation (IPC).
d. MM Systems Corporation.
e. Nystrom, Inc.
f. Watson Bowman Acme Corp.

2. Application: Ceiling to ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Seal: Preformed elastomeric membranes or extrusions.
5. Color: As selected by Architect from manufacturer's full range.

B. Elastomeric-Seal Ceiling Joint Cover For Acoustical Ceiling-to-Wall Joints: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Speciallties; FCFC-200 Series or comparable product by one of the following:

a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
b. Balco, Inc.
c. InPro Corporation (IPC).
d. MM Systems Corporation.
e. Nystrom, Inc.
f. Watson Bowman Acme Corp.

2. Application: Wall to ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.

4. Seal: Preformed elastomeric membranes or extrusions.

C. Color: As selected by Architect from manufacturer's full range.

2.6 MATERIALS

A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.

B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Fire Barriers: Any material or material combination, to comply with performance criteria for required fire-resistance rating.

D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M.

2.7 ACCESSORIES

A. Manufacturer's standard attachment devices, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies.

C. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

D. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
2. Install frames in continuous contact with adjacent surfaces.

a. Shimming is not permitted.

3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

E. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

F. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

G. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

3.2 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 07 9513.13

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Pioneer Industries, Inc.

4. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
    d. Edge Construction: Model 2, Seamless.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

    a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
    b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
d. Edge Construction: Model 2, Seamless.
e. Core: Polyurethane.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 3.4 when tested according to ASTM C 1363.

3. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup to suit frame size, not less than 0.042 inch thick; wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Not acceptable.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

F. Glazing: Comply with requirements in Section 08 8000 "Glazing."

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.

a. For exterior doors, fabricate doors with top closures inverted and flush, to prevent water accumulation in channel along top of door.

5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:

        1) Three anchors per jamb from 60 to 90 inches high.
        2) Four anchors per jamb from 90 to 120 inches high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Four anchors per jamb from 60 to 90 inches high.
        2) Five anchors per jamb from 90 to 96 inches high.

    c. Compression Type: Not less than two anchors in each frame.

6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.

B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.

e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 1113

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

B. Related Sections:

1. Section 08 8000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

    a. Finish veneer-faced door samples with same materials proposed for factory-finished doors.

3. Louver blade and frame sections, 6 inches long, for each material and finish specified.
4. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Source Limitations: Obtain flush wood doorsfrom single manufacturer.

C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to NFPA 252 .

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers for all doors: Subject to compliance with requirements, provide all flush wood doors from one of the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham; an Assa Abloy Group company.
4. Lambton Doors.
5. Marshfield Door Systems, Inc.
6. Mohawk Flush Doors, Inc.; a Masonite company.
7. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf.

B. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors :

1. Grade: Premium, with Grade A faces.
2. Species: Select white maple.
3. Cut: Quarter sliced.
4. Match between Veneer Leaves: Slip match.
5. Assembly of Veneer Leaves on Door Faces: Balance atch.
6. Pair and Set Match: Provide for doors hung in same opening.
7. Exposed Vertical and Top Edges: Applied wood edges of same species as faces and covering edges of crossbands.
8. Core: Structural composite lumber.
9. Core for Fire-Rated Doors: Manufacturer's standard mineral core tested and UL-listed to meet fire ratings indicated.
10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
11. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LOUVERS AND LIGHT FRAMES

A. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.

1. Wood Species: Same species as door faces.

B. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads .
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

C. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

D. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

D. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings in non-fire-rated doors with wood moldings. Trip openings in fire-rated doors with wood-veneer-wrapped fire-rated moldings where compatible with fire-rating requirements indicated, and steel moldings only where wood-veneer-wrapped moldings cannot meet fire-rating requirements.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 8000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-6 catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Filled finish.

5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 7100 "Door Hardware" and Section 08 7111 "Door Hardware (Descriptive Specification)."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

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.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1416

SECTION 08 3113 - 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:

1. Access doors and frames for walls and ceilings.

1.3 COORDINATION

A. G.C. shall be responsible for providing all access panels required to access concealed equipment, valves, controls and the like. Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified under "ACTION SUBMITTALS" Article.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

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. Acudor Products, Inc.
2. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
3. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
4. Karp Associates, Inc.
5. Larsen's Manufacturing Company.
6. Milcor Inc.
7. Nystrom, Inc.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges:

1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: Wall and ceiling.
3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.

    a. Finish: Factory prime.

4. Frame Material: Same material, thickness, and finish as door.
5. Hinges: Manufacturer's standard.

D. Louvered Access Doors and Frames:

1. Provide where in location indicated in Drawings for access into concealed space in over-built roof construction, and elsewhere where indicated.

2. Assembly Description:

   a. Similar construction to Flush Access Doors with Exposed Flanges.

   b. Provide louvered door face, comprised of horizontal, parallel rows of openings formed by slitting and deforming the door face.

3. Gage: 14 gage steel door; 16 gage frame.

4. Finish: Primed for Field Painting
5. Label: Field-label in neat stencilled or block-lettered paint or indelible ink "ACCESS TO CONCEALED ROOF SPACE" on face of access door, or on painted steel sheet or FRT plywood permanently affixed to deck, directly adjacent to access door.
6. Hinges: Manufacturer standard.

E. Hardware:

1. Latch: Cam latch operated by screwdriver .

   a. Provide cam latch hardware for all access doors and frames, except where indicated otherwise.

2. Lock: Cylinder.

   a. Provide locking hardware only where specifically indicated.

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. Frame Anchors: Same type as door face.

D. 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. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish 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 board securely attached to perimeter of frames.
2. Provide mounting holes in frames for attachment of units to metal or wood framing.
3. Provide mounting holes in frame for attachment of masonry anchors.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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.

D. Steel and Metallic-Coated-Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

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.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 3113

SECTION 08 3516 - FOUR-FOLD DOOR SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes Four-Fold metal doors with surface mounted tube frames.

B. Operation of Four-Fold metal doors includes overhead mounted electro-mechanical operators.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of four-fold door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturers product data.

1. Include fabrication and installation of Four-Fold metal doors including plans, elevations, sections, details of components, hardware, operating mechanism, and attachments to the other units of Work. Include wiring diagrams for coordination with electrical trade.

1.4 QUALITY ASSURANCE

A. Doors shall be designed to withstand external or internal horizontal wind loads of **(25)** pounds minimum per square foot. The maximum allowable deflection shall not exceed 1/120 of the span. Fiber stresses in main members shall be limited to 27,000 pounds per square inch. Steel frames shall be designed in accordance with the AISC Steel Construction Manual.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling.

B. Handle materials carefully to prevent damage.

1.6 WARRANTY

A. The door manufacturer shall provide a written standard limited warranty for material and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitation: Obtain four fold doors from single source from single manufacturer.

1. Obtain operators and controls from four fold door manufacturer.

B. Basis of Design Manufacturer: Four-Fold industrial metal doors manufactured by Door Engineering and Manufacturing or equal products by other approved manufacturers.

2.2 FOUR-FOLD DOOR ASSEMBLY

A. Basis of Design Product: Subject to compliance with requirements, provide FF300 Series, Glazed as manufactured by Door Engineering, A Senneca Company or approved equivalent product.

B. Material:

1. Steel Tube: ASTM A513 and ASTM A500/A500M
2. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.
3. Hardware: Manufacturer¢s standard components.
4. Fasteners: Zinc-coated steel.

C. Construction: Door framing shall be minimum 11-gauge structural steel tube with 14-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

D. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of minimum TS6x4x0.25, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports and operator supports shall be factory attached.

E. Factory finish: Door Panels and Tube Frames shall be finished with manufacturers standard PPG Spectracron epoxy primer and polyurethane top coat. Customer to select from Manufacturer¢s standard color chart or furnish sample to match.

1. Operator and operating hardware shall be powder-coated manufacturers standard gray.

F. Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.

1. All hardware, including hinges and trolleys, shall be bolted to the panel for easy removal for service or panel replacement.
2. Doors up to 16 wide and under 30psf windload shall require no floor mounted supports, guides or tracks.
3. Top tracks shall be adjustable on the end track hangers to allow for adjustment of the door panels in the open position and easily replaceable without removal of the door framing or operators.

G. Hinges: Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Fold hinges shall be stainless steel and be dual shear with two thrust bearings. All bearings shall be completely concealed within the hinge barrel and include grease zerks. All hinge pins shall be minimum ¾ diameter hardened steel.

H. Hinge Guards: Provide plastic guards at jamb hinges to prevent access through hinge space.

I. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16 cloth inserted neoprene and include no exposed fasteners on the exterior face of the panel. Weatherstripping at sill shall include two 1/16 cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.

J. Perimeter Weatherstripping: Provide jamb and head weatherstipping of 1/16 cloth-inserted neoprene bulb (or closed cell neoprene).

K. Vision Panels: Provide 1 insulated, tempered, vision panels of the size, shape and location as noted on the drawings.

2.3 OPERATOR

A. Each Four-Fold door shall be operated by an overhead mounted electro-mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to the rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.

B. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to manual operation.

C. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall coordinated and provided to comply with the building electrical system as indicated on the drawings.

D. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards. Incoming electrical shall be as indicated within drawings.

1. Control panel assemblies shall be UL listed as per NFPA70.
2. Controls shall include a programmable logic controller with digital message display or LED indicators. Controller shall include programmable close timers and programmable inputs/outputs.
3. Controls shall include a variable frequency drive with independent adjustment of the opening and closing speeds.
4. Enclosures shall be NEMA 4 with disconnect switch.
5. Pushbuttons (interior) for each door shall have one (1) momentary pressure three-button push-button station marked ÓOPEN, ÓCLOSE and ÓSTOP. Push button enclosure shall be NEMA 4.
6. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
7. Safety edges: Provide 4-wire fail-safe electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.
8. Photo eyes: Provide (1) exterior, jamb mounted, light Curtain type photo eyes, NEMA 4 rated. Photo eye shall cover from floor level to 72 above floor.
9. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor with pre-open and pre-close safety fields. Sensor shall be LZR-Widescan or equal.
10. Radio Controls: Provide five (5) radio receivers and (5) single button remotes per door. Remotes shall open and close doors with a single button.

11. Timer Activation Loop Detectors: Provide pulse on exit type loop detector to activate auto close timer once loop has been activated and cleared, include hand/auto switch to deactivate timer. G.C. to coordinate installation of preformed loop with installer prior to exterior apron being poured.

12. Wiring: Door manufacturer shall supply controls and components only. Electrical contractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Four-Fold metal doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors. Permanent or temporary electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.

B. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

3.2 ADJUSTING AND CLEANING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION

SECTION 08 3613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Bidding Requirements, Contract Requirements in Division 0 and all applicable Division 1 sections.

1.2 SUMMARY

A. This Section includes four-fold, side-acting metal doors with surface mounted tube frames.

B. Operation of four-fold metal doors includes overhead mounted electro-mechanical operators.

1.3 DEFINITIONS

A. Four-Fold Metal Door: Non-proprietary, generic term for a motorized 4-panel, side-folding service door system available from several manufacturers.

1.4 SUBMITTALS

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

B. Product Data for each type of product specified consisting of manufacturer's technical Product Data and installation instructions for each type of door required, including data substantiating that products comply with requirements.

C. Submittal Drawings showing fabrication and installation of four-fold metal doors including plans, elevations, sections, details of components, hardware, operating mechanism, and attachments to the other units of Work. Include wiring diagrams for coordination with electrical trade.

D. Reference list including (5) successful installations of this type of door within the past two (2) years.

1.5 QUALITY ASSURANCE

A. Doors shall be designed to withstand external or internal horizontal wind loads as noted on the structural drawings. The maximum allowable deflection shall not exceed 1/120 of the span. Fiber stresses in main members shall be limited to 27,000 pounds per square inch. Steel frames shall be designed in accordance with the AISC "Steel Construction Manual".

B. Door manufacturer shall have at least 10 year's experience in manufacturing door type specified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling.

B. Handle materials carefully to prevent damage.

1.7 WARRANTY

A. The door manufacturer shall provide a written standard limited warranty for material and workmanship.

1. Terms: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Subject to compliance with requirements, provide Door Engineering and Manufacturing; Four-Fold FF300 - Glazed and all operating hardware and accessories necessary for operation, or comparable product by one of the following:

1. Clear Fold.
2. Electric Power Door.
3. Raynor.

2.2 MATERIALS

A. Steel Tube: ASTM A513 and ASTM A500/A500M

B. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.

C. Hardware: Manufacturer's standard components.

D. Fasteners: Zinc-coated steel.

2.3 FOUR-FOLD DOORS

A. Construction: Door framing shall be minimum 11-gauge structural steel tube with 14-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

B. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of minimum TS6x4x0.25, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports, and operator supports shall be factory attached.

C. Factory finish: Door Panels and Tube Frames shall be finished with manufacturer's standard epoxy primer and polyurethane topcoat.

1. Color: As selected by Architect from Manufacturer's full range of standard colors.
2. Operator and operating hardware shall be powder-coated manufacturer's standard gray.

D. Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.

1. All hardware, including hinges and trolleys, shall be bolted to the panel for easy removal for service or panel replacement.
2. Doors up to 16 feet wide and under 30 psf wind load shall require no floor mounted supports, guides or tracks.
3. Top tracks shall be adjustable on the end track hangers to allow for adjustment of the door panels in the open position and easily replaceable without removal of the door framing or operators.

E. Hinges: Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Fold hinges shall be stainless steel and be dual shear with two thrust bearings. All bearings shall be completely concealed within the hinge barrel and include grease zerk fittings. All hinge pins shall be minimum ¾" diameter hardened steel.

F. Hinge Guards: Provide plastic guards at jamb hinges to prevent access through hinge space.

G. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16" cloth inserted neoprene and include no exposed fasteners on the exterior face of the panel. Weatherstripping at sill shall include two 1/16" cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.

H. Perimeter Weatherstripping: Provide jamb and head weatherstripping of 1/16" cloth-inserted neoprene bulb (or closed cell neoprene).

I. Vision Panels: Provide 1" insulated, tempered, vision panels of the custom size, shape and location indicated in the drawings.

J. Opaque Panels: Provide insulated, steel-skinned opaque panels of the custom size, shape, and configuration indicated in the Drawings.

K. Shrouds and Enclosures: Provide manufacturer's standard metal shrouds and enclosures at head of door around operating parts to protect components from damage, debris, and dust contamination, including operator shroud, and top closure for horizontal tracks.

2.4 OPERATOR

A. Each four-fold door shall be operated by an overhead mounted electro-mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to the rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings, and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.

B. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to manual operation.

C. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall be wound for three phase 208/230/480 VAC, 60 Hertz operation.

D. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards.

1. Control panel assemblies shall be UL listed as per NFPA70.
2. Controls shall include a programmable logic controller with digital message display or LED indicators. Controller shall include programmable close timers and programmable inputs/outputs.

3. Controls shall include a variable frequency drive with independent adjustment of the opening and closing speeds.
4. Enclosures shall be NEMA 4 with disconnect switch.
5. Pushbuttons (interior) for each door shall have one (1) momentary pressure three-button push-button station marked "OPEN", "CLOSE" and "STOP". Push button enclosure shall be NEMA 4.
6. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
7. Safety edges: Provide 4-wire fail-safe electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.
8. Photo eyes: Provide (1) exterior, jamb mounted, light curtain type photo eye, NEMA 4 rated. Photo eye shall cover from floor level to 72" above floor.
9. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor with pre-open and pre-close safety fields. Basis-of-Design: Door Engineering; LZR-Widescan, or comparable product by same manufacturer as door.
10. Radio controls: Provide one (1) radio receiver and (2) single button remotes per door. Remotes shall be configured to open and close doors with a single button.
11. Wiring: Door manufacturer shall supply controls and components only. Electrical contractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring.

E. Manual Operation: Provide manufacturer's optional heavy-duty manual operation hardware that allows all door panels to be disengaged from motor operator by actuation of a single pull-cord device, and then manually pushed open and closed, without requiring detachment of tension springs, resetting of operator or motor, or disassembly of door or operator hardware. Door operator system shall automatically re-engage when manually-operated doors are returned to closed position, and shall not require re-setting of the motor, operator, or controls, nor disassemble or re-assembly of operator system components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install four-fold metal doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors. Permanent or temporary electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.

B. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

3.2 ADJUSTING AND CLEANING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION 08 3613

SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior and interior storefront framing.
2. Exterior and interior manual-swing entrance doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: 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.

C. Samples: For each 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.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

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.

1.6 WARRANTY

A. Special 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. Warranty Period: Two 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, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

D. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

   a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft..

2. Entrance Doors:

   a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft.at a static-air-pressure differential of 1.57 lbf/sq. ft..
   b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft.at a static-air-pressure differential of 1.57 lbf/sq. ft..

F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

G. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq.ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35as determined according to NFRC 200.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer; Tri-Fab VG 451T Thermal Framing System or comparable product by one of the following:

1. EFCO Corporation.
2. Oldcastle BuildingEnvelope.
3. TRACO.
4. Tubelite.
5. YKK AP America Inc.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken .
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

   a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 2- to 2-1/4-inch overall thickness, with minimum 0.125-inch-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 nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

   a. Provide nonremovable glazing stops on outside of door.

4. Basis-of-Design: Subject to compliance with requirements, provide Kawneer; 350T Insulpour Thermal Entrance, or comparable product by same manufacturer as framing system.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 7100 "Door Hardware."

2.6 GLAZING

A. Glazing: Comply with Section 08 8000 "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.

D. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 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 according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. 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.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 9200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 08 8000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: 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 according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two tests in areas as directed by Architect.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 08 4113

SECTION 08 4413 - GLAZED ALUMINUM CURTAIN WALLS

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: Architectural Aluminum Curtain Wall Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing.

B. Related Sections.

1. 07 2726 "Fluid-Applied Membrane Air Barriers".
2. 07 9200 "Joint Sealants".
3. 08 4113 "Aluminum-Framed Entrances and Storefronts".
4. 08 8000 "Glazing".

1.3 DEFINITIONS

A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufactures Association (AAMA) - AAMA Glossary (AAMA AG).

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads. Failure also includes the following.

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Loosening or weakening of fasteners, attachments, and other components.
d. Failure of operating units.

B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind loads: Provide Curtain Wall system; include anchorage, capable of withstanding wind load design pressures indicated in the Drawings. The design pressures are based on the Building Codes indicated in the G Series Drawings.

D. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 6.2 psf (300 Pa).

E. Water Resistance, (static): The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.

F. Water Resistance, (dynamic): The test specimen shall be tested in accordance with AAMA 501.1. There shall be no leakage at an air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.

G. Uniform Load: A static air design load of 40 psf (1915 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member at design load. At structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

H. Seismic: When tested to AAMA 501.4, system must meet design displacement (elastic) of 0.010 x the story height and ultimate displacement (inelastic) of 1.5 x the design displacement.

I. Energy Efficiency:

1. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than: 0.38 BTU/hr/ft2 /°F per NFRC 100.

J. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than 68frame and 59glass (clear glass).

K. Sound Transmission Loss: When tested to ASTM E90, the Sound Transmission Class (STC) shall not be less than 31 and the outdoor-indoor transmission class (OITC) shall not be less than 25 based upon 1" (25.4) insulating glass.

1.5 SUBMITTALS

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

C. Delegated Design: Provide signed and sealed statement, prepared by Structural Engineer of Record registered in the State of Pennsylvania, indicating they have designed the curtain wall systems to meet or exceed Building Code requirements and the requirements indicated herein.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed curtain wall systems, made from 12" lengths of full-size components and showing details of the following.

1. Joinery.
2. Glazing.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer who has had successful experience with installation of the same or similar systems required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed performance requirements.

C. Source Limitations: Obtain aluminum curtain wall system through one source from a single manufacturer.

D. 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 modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for type(s) of curtain wall elevation(s) indicated, in location(s) shown on Drawings.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination".

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.

1. Warranty Period: Two (2) years from Date of Substantial Completion of the project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc.; 1600 Wall System 2 Curtain Wall with SSG option where indicated, 6 ½ inch frame depth option, or comparable products by another manufacturer, including, but not limited to, the following:
1. CR Laurence.
2. EFCO.
3. Oldcastle Building Envelope.
4. Tubelite.
5. Vitalite
6. Vistawall International.
7. YKK.

B. Tested to AAMA 501, ASTM E 1886, E 1996 and TAS 201, 202, 203.

2.2 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.78) wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.

B. Aluminum sheet alloy: Shall meet the requirements of ASTM B209.

C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.

D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

E. Pressure Plate: Pressure plate shall be aluminum and fastened to the mullion with stainless steel screws.

F. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

G. Sealant: For sealants required within fabricated curtain wall system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

H. Thermal Barrier: Thermal separator shall be extruded of a silicone compatible elastomer that provides a minimum 1/4" (6.3) separation.

I. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 CURTAIN WALL FRAMING

A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Glazing System: Structural silicone glazed (SSG).
2. Glazing Plane: Front.

B. Glass: 1 inch.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Framing Sealants: Shall be suitable for glazed aluminum curtain wall as recommended by sealant manufacturer.

E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.

F. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

G. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

H. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle curtain wall material and components to avoid damage. Protect curtain wall material against damage from elements, construction activities, and other hazards before, during and after installation.

2.4 GLAZING

A. Glazing: Comply with Division 08 Section "Glazing".

B. Glazing Gaskets: Gaskets to meet the requirements of ASTM C864.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: As recommended by manufacturer for joint type.

2.5 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-milthickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. 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.
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.
7. Internal weeping system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

C. Curtain Wall Framing: Fabricate components for assembly using shear block system following manufacturer's standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat.
1. Color and gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, 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 INSTALLATION

A. General: Install curtain wall systems plumb, level, and true to line, without warp or rack of frames with manufacturer's prescribed tolerances and installation instructions. Provide support and anchor in place.

1. Dissimilar Materials: Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
2. Glazing: Glass shall be outside glazed and held in place with extruded aluminum pressure plates anchored to the mullion using stainless steel fasteners spaced no greater than 9" on center.
3. Water Drainage: Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations. Weep holes shall be located in the horizontal pressure plates and covers to divert water to the exterior of the building.

B. Related Products Installation Requirements.

1. Sealants (Perimeter): Refer to Division 07 section, Joint Sealants.
2. Entrances: Refer to Division 08 section, Aluminum-Framed Entrances and Storefronts.
3. Glass: Refer to Division 08 section, Glazing.

a. Reference: ANSI Z97.1, CPSC 16 CFR 1201 and GANA Glazing Manual.

3.3 FIELD QUALITY CONTROL

A. Field Tests: Architect shall select curtain wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. Testing: Engage a qualified independent testing agency.

a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.
b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).

B. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING AND PROTECTION

A. Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum curtain wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

B. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 4413

SECTION 08 5619 - PASS-THROUGH WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Flush-mount pass-through windows.

1.3 REFERENCES

A. ASTM A 240 - Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

B. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM B 221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

E. ASTM C 1048 - Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pass-through window indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required).

B. Shop Drawings: Show fabrication and installation details of pass-through windows. Include plans, elevations, sections, details, and attachments to other Work.

C. Samples: For each pass-through windows material, at least 3 by 5 inches in size, in specified finish.

D. Schedule: Provide complete pass-through windows schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each type of pass-through window.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit manufacturer's operation and maintenance manual, including operation, maintenance, adjustment, and cleaning instructions, trouble shooting guide, parts list, and electrical wiring diagrams.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish any proprietary or specialized maintenance tools that may be required for periodic maintenance.

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Minimum of 25 years successful experience continuously manufacturing pass-thru windows.

B. Source Limitations: Obtain doors and frames through one source from a single manufacturer.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation.

PART 2 - PRODUCTS

2.1 FLUSH MOUNT PASS-THROUGH WINDOWS W6 AND W7

A. Basis-of-Design: Subject to compliance with requirements, provide Ready Access, Inc.; 275 Single Panel Manual Open / Self Closing Slider Window, or comparable products from another manufacturer.

B. Rough Opening: As indicated.

C. Operation: Manual-opening, and self-closing, with automatic mechanical locking each time door closes.

D. Door Type: Single-sliding panel, and equal-sized fixed panel.

E. Opening Direction: As indicated.

F. Frame: Extruded aluminum, ASTM B 221, Alloy 6063-T6 and 6063-T52.

G. Glazing: ¼ inch clear fully tempered safety glazing ASTM C 1048.

H. Hardware and Fasteners:

1. Stainless steel rivets.
2. Zinc-plated steel screws.
3. Manufacturer's standard Delrin or stainless steel handles, latches, and catches.

I. Bottom Sill: Angled downward, track-free.

2.2 FABRICATION

A. Factory-assemble units in their entirety.

2.3 FINISHES

A. Powder-Coated Paint:

1. Tiger Drylac Series 49; Architect's choice from full range of RAL colors.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise installers of other work about specific requirements relating to pass-through window installation, including sizes of openings to receive units, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing pass-through windows.

B. Install pass-thru windows plumb, level, square, true to line, and without warp or rack.

C. Install pass-thru window components weathertight.

D. Anchor pass-thru windows securely in place to supports. Use attachment methods permitting adjustment for construction tolerances, irregularities, alignment, and expansion and contraction.

E. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.

F. Install joint sealants as specified in Section 07 9200.

3.3 ADJUSTING AND CLEANING

A. Adjust units for proper operation.

B. Remove and replace warped, bowed, or otherwise damaged pass-through windows.

END OF SECTION 08 5619

SECTION 08 7100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware not specified in Division 28 sections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include 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.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 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).

1.6 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. Electromagnetic Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. 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 according to NFPA 252 or UL 10C.

B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" the DOT's "ADA Standards for Transportation Facilities" the ABA standards of the Federal agency having jurisdiction ICC A117.1 HUD's "Fair Housing Accessibility Guidelines" Insert regulation.

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3.

2.3 HINGES

A. Butt Hinges: BHMA A156.1. Provide template-produced hinges for installation on hollow-metal doors, aluminum storefront doors, and hollow-metal frames.

1. Type: Five-knuckle, full mortise, concealed bearing.
2. Weight: Heavy weight.
3. Size: 4.5 inches by 4.5 inches.
4. Base metal: Stainless steel.
5. Bearing type: Concealed, oil- and grease-free, maintenance-free.
6. Pin type: stainless steel.
7. Finish: US 32D, Satin Stainless Steel.
8. Non-Removable Pin Option: Where indicated, provide manufacturer's standard NRP non-removable pins held in place by set screw through hinge barrel, concealed when hinge is in closed position.
9. Electrified Hinge Option: Where indicated, provide manufacturer's standard concealed wiring option for conducting current to electrified door hardware. Provide hinge with appropriate number of conductors and wire gauge as required by electrified hardware.
10. Security Stud Option: Where indicated, provide manufacturer's optional round stud welded to one hinge leaf, and aligning hole in the opposite leaf.

11. Basis-of-Design Product: Subject to compliance with requirements, provide Stanley Commercial Hardware; CB199, with options enumerated in each Hardware Set, or comparable product by one of the following:

    a. Baldwin Hardware Corporation.
    b. Bommer Industries, Inc.
    c. Don-Jo Mfg., Inc.
    d. Hager Companies.
    e. McKinney Products Company; an ASSA ABLOY Group company.

2.4 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26-1996, Grade 1; minimum 0.120-inch- thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Type: Full mortise.
2. Weight: Heavy weight.
3. Size: Full height of door.
4. Base metal: Extruded Aluminum.
5. Bearing type: Integral polymer PTFE bearing.
6. Hinge type: meshed gear profile, with full covering.
7. Finish: Clear Satin Anodized.
8. Electrified Hinge Option: Where indicated, provide manufacturer's standard concealed wiring option for conducting current to specified electrified door hardware. Provide hinge with appropriate number of conductors and wire gauge as required by electrified hardware.
9. Basis-of-Design Product: Subject to compliance with requirements, provide Stanley Commercial Hardware; Aluminum Continuous Geared Hinge 661 HD, or comparable product by one of the following:

    a. Allegion plc.
    b. Bommer Industries, Inc.
    c. Hager Companies.
    d. McKinney Products Company; an ASSA ABLOY Group company.
    e. Pemko Manufacturing Co.
    f. Zero International, Inc.

2.5 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 latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
3. Deadbolts: Minimum 1-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: ADA-accessible, "L" shaped lever consisting of a round spindle and rectangular-profile lever, with hooked end returning to within 1/2 inch of door face; and a flat-profile, square-edged, rectangular escutcheon plate 1 3/4 inches wide by 8 1/2 inches high, with concealed fasteners, prepared for key cylinder.
2. Levers: Cast Stainless Steel.

    a. Corbin Russwin; "Newport NSR"

3. Escutcheons (Roses): Solid Stainless Steel.
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. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

F. Cylindrical Locks: BHMA A156.2; Operational Grade 1; non-handed; 2 ¾" backset, 2 ¼ inch diameter cylindrical prep.

1. Functions: As indicated in the Hardware Schedule for each unit.
2. Base Metal: Stainless Steel for all exposed parts; zinc dichromated steel lock chassis.
3. Finish: BHMA 32D Satin Stainless Steel.
4. Keying: 6-pin, compatible with keyway, bitting, and keying system specified.
5. Basis-of-Design Product: Subject to compliance with requirements, provide Corbin Russwin; CL3300 Series Cylindrical Locksets or comparable product by one of the following:

    a. Hager Companies.
    b. SARGENT Manufacturing Company; ASSA ABLOY.
    c. Stanley Commercial Hardware; a division of Stanley Security Solutions.
    d. Yale Security Inc; an ASSA ABLOY Group company.

G. Mortise Locks: BHMA A156.13; Operational Grade 1; heavy steel case with steel or brass parts; Series 1000.

1. Functions: As indicated in the Hardware Schedule for each unit.
2. Base Metal: Stainless Steel for all exposed parts.
3. Finish: BHMA 32D Satin Stainless Steel.
4. Occupancy Indicator Option: Where indicated, provide manufacturer's standard engraved and color-coded "Vacant" / "Occupied" indicator on outside of door, actuated by locking mechanism; provide sectional escutcheon trim if necessary for Occupancy Indicator.
5. Keying: 6-pin, compatible with keyway, bitting, and keying system specified.

6. Basis-of-Design Product: Subject to compliance with requirements, provide Corbin Russwin; ML2000 Series Mortise Locksets or comparable product by one of the following:

    a. Hager Companies.
    b. SARGENT Manufacturing Company; ASSA ABLOY.
    c. Stanley Commercial Hardware; a division of Stanley Security Solutions.
    d. Yale Security Inc; an ASSA ABLOY Group company.

H. Auxiliary Bored Locks: BHMA A156.36, Operational Grade 1. Non-handed, 2 ¾" backset, 2 ¼ inch diameter cylindrical prep, 1 inch throw, solid steel bolt, with free-spinning steel pin insert.

1. Functions: As indicated in the Hardware Schedule for each unit.
2. Base Metal: Stainless Steel for all exposed parts; dichromate- or rust-inhibitive-plated steel body.
3. Finish: BHMA 32D Satin Stainless Steel.
4. Thumbturns: ADA-compliant, requiring no pinching or grasping to rotate to an unlocked position; with cam compatible with hardware functions indicated.
5. Keying: 6-pin, compatible with keyway, bitting, and keying system specified.
6. Basis-of-Design Product: Subject to compliance with requirements, provide Corbin Russwin; DL3200 Series Deadlocks or comparable product by one of the following:

    a. Hager Companies.
    b. SARGENT Manufacturing Company; ASSA ABLOY.
    c. Stanley Commercial Hardware; a division of Stanley Security Solutions.
    d. Yale Security Inc; an ASSA ABLOY Group company.

2.6 ELECTROMECHANICAL LOCKS

A. Cylindrical Battery-Operated Cypher Locks: BHMA A156.2, Operational Grade 1. Handed, with both battery-powered electronic control and mechanical key control of bolt; with numeric keypad on outside.

1. Operation: Merchanical by key in outside cylinder, and electronically by presentation of credentials in outside keypad.
2. Function: Multi-function, field-programmable, including but not limited to locking and unlocking of bolt by key and keypad and by interior thumbturn, and timed unlocking and re-locking of bolt by key and keypad.
3. Operation: Stand-alone access control, with direct download from each lockset memory via a separate data transfer device; mechanical access by key and electronic access via keypad; battery-operated.
4. Codes:

    a. Variable length, user-programmable, between 1 and 6 digits.
    b. With master, supervisory, emergency, and temporary user codes.
    c. Allows code storage for up to 2,000 individual simultaneous users per lockset, and 20,000 for the entire system database.

5. Programmability: Dual, via keypad or viatransfer of programming from computer app to locksets using DTD Digital Transfer Device.
6. Auditing: Allows an audit trail of not less than 2,000 cycles.
7. Power: On-board battery.

    a. No less than estimated 75,000 cycles, and with low battery indicator.
    b. Format: Six (6) AA batteries.

8. Clock:

    a. On-board real-time clock with date and time.
    b. Automatic Daylight Savings time.
    c. Programmable automatic lock and unlock by time clock option.

9. Software: Proprietary software allowing programming and interrogation of each stand-alone lockset, provided on DVD medium or downloadable.
10. DTD Digital Transfer Device: Provide one (1) manufacturer's recommended battery-operated, portable DTD with LCD screen, including cables for interface with computer and locksets.
11. Basis-of-Design: Subject to compliance with requirements, provide Corbin-Russwin; Access Series, M801, CL33800 AC2 Cylindrical Lock, or comparable product by the same manufacturer as Cylindrical Locksets.

2.7 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.

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. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
    b. Allegion plc.
    c. Dortronics Systems, Inc.
    d. DynaLock Corp.
    e. HES, Inc.; an ASSA ABLOY Group company.
    f. PDQ Manufacturing.
    g. Rutherford Controls Int'l. Corp.
    h. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
    i. Security Door Controls.
    j. Stanley Commercial Hardware; a division of Stanley Security Solutions.
    k. Trine Access Technology.

2.8 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Finish: US 26D Satin Chrome Plated.
2. Strikes: Provide mortise strike for head, and spring-loaded, flanged dust-proof strike for floor.

3. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
b. Allegion plc.
c. Burns Manufacturing Incorporated.
d. Don-Jo Mfg., Inc.
e. Door Controls International, Inc.
f. Hiawatha, Inc; a division of the Activar Construction Products Group.
g. Trimco.

2.9 CONSTANT-LATCHING FLUSH BOLTS

A. Constant-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge. Include wear plates.

1. Finish: US 26D Satin Chrome Plated.
2. Strikes: Provide mortise strike for head, and spring-loaded, flanged dust-proof strike for floor.
3. Operation: Top and bottom bolts are interconnected by lever or cable concealed within door stile. Top and bottom bolts remain constantly latched until manually released. Spring-loaded release lever on top bolt simultaneously retracts and holds both top and bottom bolts in open position, allowing free opening of door leaf. Spring loaded plunger on top bolt automatically re-latches both top and bottom bolts when door leaf is returned to closed position.

a. Wood and Metal Door Options: Provide manufacturer's standard option for wood or for metal door leaves, to match door leaf construction for each instance.
b. Top Bolt Only: Where indicated, provide single top bolt only option.
c. Fire-rated Option: For fire-rated doors, provide manufacturer's standard option tested and approved for fire-rated doors.

4. Configuration: Top and bottom bolt housings flush-mortised into strike edge of door leaf, completely concealed from view when door is in closed position.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Door Controls International, Inc.
c. Ives
d. Rixson
e. Trimco.

2.10 EXIT DEVICES

A. Exit Devices: BHMA A156.3.

1. Type: Concealed Vertical Rod, or Mortise, or Mortise with Electric Latch Retraction types as indicated in the Hardware Schedule.
2. Configuration: Narrow design with square housing and full-length push-pad, and lever-type trim where exterior trim is indicated.
3. Base metal: Stainless steel for exposed parts.
4. Finish: US32D Satin Stainless Steel.
5. Basis-of-Design Products: Subject to compliance with requirements, provide the following products for each type of exit device from Sargent, an ASSA ABLOY Company:

a. Concealed Vertical Rod Type for Hollow Metal Doors: MD8600 Series.

1) Where indicated, provide Electrified Remote Latch Retraction option.

b. Concealed Vertical Rod Type for Aluminum Storefront Doors: AD8400 Series.

1) Where indicated, provide Electrified Remote Latch Retraction option.

c. Mortise Type for Hollow Metal and Wood Doors: 8900 Series.
d. Rim Latch Type for Hollow Metal and Wood Doors: 8800 Series.

2.11 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Best Access Systems; Stanley Security Solutions, Inc.
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
c. Medeco Security Locks; an ASSA ABLOY Group company.
d. SARGENT Manufacturing Company; ASSA ABLOY.
e. Stanley Commercial Hardware; a division of Stanley Security Solutions.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Removable; of types to suit each type of specified lockset.

2. Type: M, mechanical.
3. Pins: Six (6).

C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.12 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Grand Master Key System: Provide a Three-Level Grand Master Key System comprised of multiple Master Key sub-systems with Change Keys, and a Grand Master key that operates all cylinders. Assume not less than three (3) Master Key sub-systems under the Grand Master, each with multiple Change Keys.
2. Keying Subcontractor shall conduct a Keying Conference with the Owner to establish the following:

a. Number of master key sub-systems.
b. Number of change Keys within each master key sub-system.
c. Locks within each master key sub-system that shall be keyed to the same change key, or keyed separately.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2.13 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Key Boxes and Cabinets.
b. GE Security, Inc.
c. HPC, Inc.
d. Lund Equipment Co., Inc.
e. MMF Industries.
f. TelKee; Oasis International.

2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.14 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.

B. Decorative Bar Pulls: 1 1/4 inch diameter stainless steel vertical bar with flat closed ends, attached to door with (2) offset standoffs and heavy-duty through-bolt mounting; 2 3/4 inch standoff from face of door; total overall length 60 inches; polished stainless steel finish with brushed stainless steel gripping surface.

1. Basis-of-Design Product: Rockwood; RM3411 NeoTek Offset Pull - Flat Ends, Mounting Type 1HD.

C. Pull Plates: 8 inch high x 1 inch wide "D" shaped stainless steel fixed pull with square outside edges and rounded inner gripping surface, and 4 inch by 16 inch by 0.062 inch stainless steel mounting plate; US32D brushed stainless steel finish; through-bolted, with flat head machine screws and finishing washers.

1. Basis-of-Design Product: Rockwood; 126 x 70C - 4" x 16" Pull Plate.

D. Push Plates: 4 inch x 16 inch x 0.062 inch flat stainless steel, US32D satin finish; fastened to door with 6 oval head stainless steel screws.

1. Basis-of-Design Product: Rockwood; 71C - 4" x 16" Push Plate.

2.15 ACCESSORIES FOR PAIRS OF DOORS

A. Astragals: BHMA A156.22.

1. Mortised Smoke Seal Astragals: 2-part smoke-seal-rated system for installation in vertical mortises machined into the meeting stiles of pairs of doors, consisting of (1) extruded aluminum insert in one leaf, and (1) extruded aluminum insert with neoprene bulb seal and fin in opposing leaf; bulb seal presses against opposing aluminum insert to create a smoke-tight seal.

a. Basis-of-Design: Zero International; 36AA 36" Clear Anodized Mortised Astragal with Neoprene.

2. Surface Fire and Smoke Seal Astragal: 1-part smoke seal system comprised of a resilient double-fin profile and additional heat-activated intumescent seals, with self-adhesive backing installed to meeting rail or inactive leaf of a pair of doors to create a smoke-tight and heat-resistant seal.

a. Basis-of-Design: NGP National Guard Products; NGP Edge, Intumescent with TPE Fins Fire and Smoke Seal.

3. "T" Astragal: Extruded mill aluminum "T" profile with captive vinyl finned weatherstrip, in continuous length to match door, for installation on the exterior meeting stile edge of one door leaf in a pair of doors to create a weathertight, draft-resistant seal.

a. Basis-of-Design: Pemko; 38ZA75 Double Door Weatherstrip T-Astragal With Vinyl Insert.

B. Coordinators: BHMA A156.3; Tubular steel body with protruding spring-loaded door control tabs, configured to mount directly to door frame rabbet, with inner operating components completely concealed within housing; custom-length to suit door opening width and configured for compatibility with specific hardware indicated.

1. Basis-of-Design: Rockwood NX23600 Series Door Coordinator.

2.16 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written 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.

B. Provide Surface Closers of configuration and arm type for mounting on interior and room-side of doors, unless specifically indicated otherwise.

1. For push side closer mounting, provide parallel arm option.
2. For pull side closer mounting, provide track arm option.

C. Provide full metal cover option.

D. Provide overhead stop option where indicated in Door Hardware Sets. Stop point shall be field-adjustable.

E. Provide overhead holder option where indicated in Door Hardware Sets. Holdopen point shall be field-adjustable.

F. Size closer for each door based on Manufacturer's recommendation for weight and height of door; wind conditions; and location of closer.

G. Where overhead door control items are indicated to be used on the same door leaf in conjunction with surface closers, coordinate the closer type, mounting location, and bracket types to ensure full operation and intended functionality of closer and overhead door control device.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Corbin-Russwin; DC8000 Series or comparable product by one of the following:

a. DORMA Architectural Hardware; a division of DORMA Group North America.
b. Hager Companies.
c. SARGENT Manufacturing Company; ASSA ABLOY.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.
e. Yale Security Inc; an ASSA ABLOY Group company.

2.17 MECHANICAL STOPS AND HOLDERS

A. Wall-Mounted Stops: BHMA A156.16.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Rockwood; #403 or comparable product by one of the following:

a. Baldwin Hardware Corporation.
b. Hager Companies.
c. Trimco.

B. Floor-Mounted Stops: BHMA A156.16.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Rockwood; #440 or comparable product by one of the following:

a. Baldwin Hardware Corporation.
b. Hager Companies.
c. Trimco.

2.18 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

B. General: Track-and-arm configuration, with track surface mounted to door, pivoting arm mounted to door frame, and pin of pivoting arm riding in track.

C. Material: Stainless steel base metal, US32D satin brushed finish.

D. Opening Angle: Up to 110 degrees.

E. Compression Stop Feature: Heavy-duty shock-absorber spring mechanism concealed in track, providing 5 to 7 degrees of compression before dead-stop.

F. Where indicated, provide holdopen option, with adjustable hold-open angle and tension.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Rixson; CheckMate #9 Series or comparable product by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
c. SARGENT Manufacturing Company; ASSA ABLOY.

2.19 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide NGP National Guard Products; 152VA or comparable product by one of the following:

a. Sealeze.
b. Zero International, Inc.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg, as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

2.20 DOOR SWEEPS

A. Door Sweep with Drip Cap: "U" profile extruded aluminum for slip fit over bottom edger of door, with integrally-extruded outside drip edge and removable finned resilient bulb in bottom retaining track.

1. Basis-of-Design Product: Pemko 2251AV.

2.21 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

B. Configuration: Mill-aluminum, thermally-improved, ADA-accessible, with resilient gasket bumper seal.

1. Basis-of-Design Product: Subject to compliance with requirements, provide NGP National Guard Products 896 or comparable product by one of the following:

a. Hager Companies.
b. M-D Building Products, Inc.
c. Pemko Manufacturing Co.
d. Reese Enterprises, Inc.
e. Zero International, Inc.

2.22 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- thick stainless steel; with manufacturer's standard screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Burns Manufacturing Incorporated.
c. Don-Jo Mfg., Inc.
d. Hiawatha, Inc; a division of the Activar Construction Products Group.
e. InPro Corporation (IPC).
f. Pawling Corporation.
g. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
h. Trimco.

2.23 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

1. Where indicated in the Hardware Schedule, as specified in Division 28 Specifications sections.
2. Where electrified door hardware is indicated to be provided by Owner's vendor, fully coordinate the locations, preparation, pathway, and other fabrication and installation requirements with the Owner's vendor.

2.24 FINISHES

A. Provide finishes complying with 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.

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 of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

E. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening 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 07 9200 "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. 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. Refer to 08 7100.01, "Door Hardware Schedule," directly following the end of this Specifications section.

END OF SECTION 08 7100

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, and storefront framing.
2. Glazing sealants and accessories.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 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 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:

1. AGC Glass Company North America, Inc.
2. Cardinal Glass Industries.
3. Cristacurva.
4. Dlubak Corporation.
5. Gardner Glass, Inc.
6. GGI; General Glass International.
7. Glasswerks LA, Inc.
8. GTI; Glaz-Tech Industries.
9. Guardian Industries Corp.; SunGuard.
10. Hartung Glass Industries.
11. JE Berkowitz, LP.
12. Northwestern Industries, Inc.
13. Oldcastle BuildingEnvelope?.
14. Pilkington North America.
15. Schott North America, Inc.

16. Tecnoglass.
17. Trulite Glass & Aluminum Solutions, LLC.
18. Viracon, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

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. 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.
2. 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.
3. 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: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction 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.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

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 E 2190.

1. Sealing System: Dual seals.
2. Perimeter Spacer: Aluminum with black, color anodic finish.

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: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: 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.
    b. GE Construction Sealants; Momentive Performance Materials Inc.
    c. May National Associates, Inc.; a subsidiary of Sika Corporation.
    d. Pecora Corporation.
    e. Sika Corporation.
    f. Tremco Incorporated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 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.

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.

3.2 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. Apply heel bead of elastomeric sealant.

F. 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.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 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.

3.4 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.

3.5 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.

3.6 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-1: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.7 INSULATING GLASS SCHEDULE

A. Glass Type GL-2: Clear insulating glass.

1. Overall Unit Thickness: 1 inch.
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Heat-strengthened float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Heat-strengthened float glass.
6. U-Factor: 0.38 maximum as calculated for combined glazing and worst-case window framing system.

B. Glass Type GL-3: Clear insulating safety glass.

1. Overall Unit Thickness: 1 inch.
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite: Fully tempered float glass.
6. Safety glazing required.
7. U-Factor: 0.38 maximum as calculated for combined glazing and worst-case window framing system.

C. Glass Type GL-4: Low-E-coated, clear insulating glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 60 (2) Clear + Clear.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Heat-strengthened float glass.
5. Interspace Content: Air.
6. Indoor Lite: Heat-strengthened float glass.
7. Low-E Coating: Pyrolytic on second surface.
8. U-Factor: 0.29 maximum as calculated for combined glazing and worst-case window framing system.
9. Visible Light Transmittance: 70 percent minimum.
10. Solar Heat Gain Coefficient: 0.39 maximum.

D. Glass Type GL-5: Low-E-coated, clear insulating safety glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 60 (2) Clear + Clear.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Fully tempered float glass.
5. Interspace Content: Air.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Pyrolytic on second surface.
8. U-Factor: 0.29 maximum as calculated for combined glazing and worst-case window framing system.
9. Visible Light Transmittance: 70 percent minimum.
10. Solar Heat Gain Coefficient: 0.39 maximum.
11. Safety glazing required.

END OF SECTION 08 8000

SECTION 08 8300 - MIRRORS

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. Silvered flat mirror safety glazing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

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 square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of mirror and mirror mastic.

1. Include manufacturer's certificate indicating safety glazing certification.

C. 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.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 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.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.10 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: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Avalon Glass and Mirror Company.
2. Binswanger Mirror; a division of Vitro America, Inc.
3. D & W Incorporated.
4. Donisi Mirror Company.
5. Dulles Glass.
6. Gardner Glass, Inc.
7. Gilded Mirrors, Inc.
8. Glasswerks LA, Inc.
9. Guardian Glass; SunGuard.
10. Head West.
11. Independent Mirror Industries, Inc.
12. Lenoir Mirror Company.
13. National Glass Industries.
14. Stroupe Mirror Co., Inc.
15. Sunshine Mirror.
16. Trulite Glass & Aluminum Solutions, LLC.
17. Virginia Mirror Company, Inc.
18. Walker Glass Co., Ltd.

B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

C. Source Limitations for Mirror Accessories: Obtain mirror-glazing accessories from single source.

2.2 SILVERED MIRROR SAFETY GLAZING "E25"

A. Mirrors, General: ASTM C1503; manufactured using copper-free, low-lead mirror coating process.

B. Laminated Mirrors: ASTM C1172, Type II.

1. Glass for Outer Lite: Annealed float glass, Mirror Select Quality, clear low-iron float glass with a minimum 91 percent visible light transmission.
2. Nominal Thickness for Outer Lite: 1/8 inch.
3. Glass for Inner Lite: Annealed float glass; ASTM C1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
4. Nominal Thickness for Inner Lite: 1/8 inch.
5. Interlayer: 0.030-inch- thick, clear polyvinyl-butyral.

C. Safety Glazing Products: For laminated mirrors, provide products that comply with 16 CFR 1201, Category II.

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 and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C.R. Laurence Co., Inc.
b. Franklin International.
c. Liquid Nails Adhesive.
d. Macco Adhesives.
e. OSI Sealants; Henkel Corporation.
f. Palmer Products Corporation.
g. Pecora Corporation.
h. Royal Adhesives & Sealants.
i. Sommer & Maca Industries, Inc.

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 Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.

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) Andscot Company, Inc.
2) C.R. Laurence Co., Inc.
3) Stylmark, Inc.

2. Aluminum J Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.

    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) Andscot Company, Inc.
        2) C.R. Laurence Co., Inc.
        3) Stylmark, Inc.

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.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

A. Shop fabricate mirrors to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Flat high polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

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.

1. Field-template all wall-to-wall mirror installations to account for actual field dimensions, inside and outside corner laps, reveal allowances between mirror sections, and variations in plumb and level.
2. Where mirrors are indicated to be installed on faces of doors, field-template surface-mount door hardware and cut relief openings with uniform margins around hardware, such as door lever roses and lock cylinder bezels.

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.

1. NGA Publications: "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."

B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. 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 thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
2. Install mastic as follows:

a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

d. Install mirrors with uniform edge reveals between mirror sections no wider than that indicated in the Drawings. Stripe-paint the substrate at reveals as indicated in the Drawings before mirror installation.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. 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 08 8300

SECTION 08 8813 - FIRE-RESISTANT GLAZING

PART ? - GENERAL

?.? SUMMARY

?. Section Includes:

?. Fire-protection-rated safety glazing.

?.? COORDINATION

?. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

?.? ACTION SUBMITTALS

?. Product Data: For each type of product.

?. Glass Samples: For each type of glass product; 12 inches square.

?. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

?.? WARRANTY

?. Manufacturer's Special Warranty on 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.

?. Warranty Period: Five years from date of Substantial Completion.

PART ? - PRODUCTS

?.? GLASS PRODUCTS, GENERAL

?. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

?. Safety Glazing Labeling: Permanently mark glazing with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

?.? GLASS PRODUCTS

?. Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.

?.? FIRE-PROTECTION-RATED GLAZING

?. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.

    ?. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

?. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F temperature-rise limitation; and the fire-resistance rating in minutes.

?. Fire-Protection-Rated Tempered Glass FPG-1:

    ?. Location: For 20-Minute Fire-Rated Doors and sidelites.
    ?. Material: Monolithic low-iron specialty tempered ultra-clear glass, or tint-free laminated ceramic glazing.
    ?. Thickness: No greater than 3/8 inch, nor less than 1/4 inch.
    ?. Coatings: None.
    ?. Appearance: Clear, wireless, tint-free.
    ?. Visual Light Transmittance: No less than 88%.

?. Fire Rating: 20 minutes without hose stream, approved for use in 45-minute fire-rated doors and sidelites.
?. Impact Safety Resistance: Meets CPSC 16 CFR 1201 Category I and II.
?. Products: Subject to compliance with requirements, provide SaftiFirst; SuperLite I 20 minute with Starfire Ultra-Clear Glass by PPG specialty tempered low-iron glazing, or comparably perfoming monolitihic or laminated, tint-free fire-resistive glazing without films or coatings by Technical Glass Products, Pilkington, or another manufacturer.

?. Fire-Protection-Rated Tempered Glass FPG-2:

?. Location: For 45-Minute Fire-Rated Doors and sidelites.
?. Material: Monolithic low-iron ultra-clear glass, or tint-free laminated ceramic glazing.
?. Thickness: No greater than ¾ inch, nor less than 5/16 inch.
?. Coatings: None.
?. Appearance: Clear, wireless, tint-free.
?. Visual Light Transmittance: No less than 90%.
?. Fire Rating: 45 minutes with hose stream, approved for use in 45-minute fire-rated doors and sidelites.
?. Impact Safety Resistance: Meets CPSC 16 CFR 1201 Category I and II, ANSI Z91.1 Class A and B.
?. Products: Subject to compliance with requirements, provide SaftiFirst; SuperClear 45-HS-LI, or comparably perfoming monolitihic or laminated, tint-free fire-resistive glazing without films or coatings by Technical Glass Products, Pilkington, or another manufacturer.

?.? GLAZING ACCESSORIES

?. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

?. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

?. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

?. Dow Corning Corporation; 795.
?. GE Construction Sealants; Momentive Performance Materials Inc; SilGlaze II SCS2800.
?. Tremco Incorporated; Spectrem 2.

?. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

PART ? - EXECUTION

?.? GLAZING

?. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

?. 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.

?. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

?. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

?. 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.

?. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

?. Provide spacers for glass lites where length plus width is larger than 50 inches.

?. 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.

?.? CLEANING AND PROTECTION

?. Immediately after installation, remove nonpermanent labels and clean surfaces.

?. 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.

    ?. 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 is damaged during construction period.

?.? FIRE-PROTECTION-RATED GLAZING SCHEDULE

?. Glass Type FRG-1: 20-minute fire-protection-rated glazing.

?. Glass Type FRG-2: 45-minute fire-protection-rated glazing.

END OF SECTION 08 8813

SECTION 08 9119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fixed, extruded-aluminum louvers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

C. Samples: For each type of metal finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on tests performed according to AMCA 500-L.

PART 2 - PRODUCTS

2.1 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model ELF6375X as manufactured by Ruskin or comparable product by one of the following:

a. Air Flow Company, Inc.
b. Airolite Company, LLC (The).
c. Architectural Louvers; Harray, LLC.
d. Construction Specialties, Inc.
e. Ruskin Company; Tomkins PLC. BASIS of DESIGN

2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.

4. Mullion Type: Exposed where indicated on drawings, otherwise concealed.
5. Louver Performance Ratings:

    a. Free Area: Not less than 55% (8.8 sq. ft.)for 48-inch- wide by 48-inch- high louver.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.2 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

C. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inchwire.

2.3 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.5 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.2 ADJUSTING

A. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 08 9119

SECTION 09 0561.13 - MOISTURE VAPOR EMISSION CONTROL

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. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

    a. Products specified in this Section are not a part of the Base Contract and shall be installed as an Alternate, if slab moisture measurements indicated in Division 09 floor covering Specifications sections are unacceptable for installation of floor coverings without mitigation of slab moisture.

B. Related Sections:

1. Section 01 2300 "Alternates" for locations and details of installation of Vapor Control Emission products specified in this Section.
2. Section 03 3000 "Cast-In-Place Concrete" for concrete slab substrates upon which products specified in this Section will be applied.
3. All Division 09 floor covering Specifications sections contained in this Project Manual, for details on floor coverings to be installed over Vapor Control Emission products specified in this Section.

1.3 DEFINITIONS

A. MVE: Moisture vapor emission.

B. MVER: Moisture vapor emission rate.

1.4 REFERENCES

A. Reference Standards: Refer to Section 01 4200 References and the following:

1. ASTM International (ASTM):

    a. ASTM D7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
    b. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
    c. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
    d. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
    e. ASTM F3191 - Standard Practice for Field Determination of Substrate Water Absorption (Porosity) for Substrates to Receive Resilient Flooring

2. International Concrete Repair Institute (ICRI) - Guide 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays and Concrete Repair.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each MVE-control system, for tests performed by a qualified testing agency.

C. Preinstallation testing reports.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

C. Applicator Qualifications: Trained and approved by the manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.

1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:

1. MVER: Maximum 30 lb of water/1000 sq. ft. when tested according to ASTM F1869.
2. Relative Humidity: Maximum 100 percent when tested according to ASTM F2170 using in situ probes.

B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm when tested according to ASTM E96/E96M.

C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.

2.2 MVE-CONTROL SYSTEM

A. Basis-of-Design: Subject to compliance with requirements, provide ISE Logik Industries; MVEC-710 Moisture Vapor Barrier and MVBP Bond Promoter, or comparable system of products by another manufacturer, including but not limited to the following:

1. Advanced Moisture Control, Inc.
2. ARDEX Americas.
3. BASF Corp. - Construction Chemicals.
4. Dependable, LLC.
5. Floor Seal Technology, Inc.
6. H.B. Fuller Construction Products Inc. / TEC.
7. KOSTER American Corporation.
8. LATICRETE SUPERCAP, LLC.
9. MAPEI Corporation.
10. Schnox, HPS North America, Inc.
11. Synthetics International.
12. USG Corporation.
13. UZIN a division of UFLOOR Systems Inc.

B. MVE-Control System: Fluid-applied, single-component, modified urethane (isocyanate free), membrane-forming system, and single-component, modified urethane (isocyanate free) bond promoter where necessary for compatibility with floor covering adhesives; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.
3. Emissions Requirements: Coating shall comply with either of the following:

    a. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    b. VOC Content: Provide coating with VOC content of 100 g/L or less.

2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's cement-based underlayment.

PART 3 - EXECUTION

3.1 INSTALLATION LOCATIONS

A. MVE-Control System shall be installed to interior concrete slab-on-grade substrates under all floor coverings indicated, EXCEPT the following:

1. Resinous Flooring.
2. Sealed Concrete.
3. Floor coverings that are not compatible with MVE Control System.

3.2 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.

1. Verify that concrete has achieved a minimum of 3000 psi, or 80% of design strength; whichever is greater.
2. Verify that no hydrostatic pressure exists.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of system indicates acceptance of surfaces and conditions.

3.3 PREPARATION

A. Preinstallation Testing:

1. Testing Agency: Engage a qualified testing agency to perform tests.
2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
3. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.

a. Proceed with installation only where tensile bond strength is greater than 200 psi with failure in the concrete.

B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.

1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
2. Provide concrete surface profile suitable to MVE-control system manufacturer.

a. If required by manufacturer, provide surface profile complying with ICRI 310.2R by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
b. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.

3. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
4. Fill surface depressions and irregularities with patching and leveling material.
5. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
6. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
7. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.4 INSTALLATION

A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

1. Install primers as required to comply with manufacturer's written instructions.

B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

C. Apply system, including component coats such as Bond Promoters, if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform installation inspections.

B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.

1. Verify that surface preparation meets requirements.
2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.

C. MVE-control system will be considered defective if it does not pass inspections.

3.6 PROTECTION

A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION 09 0561.13

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Delegated Design requirements for metal stud assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated Design: Submit shop drawings and Structural Engineer's certification that metal stud assemblies as indicated have been designed to meet Building Code and other requirements indicated.

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, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Delegated Design Requirements: Retain a Structural Engineer licensed in the State in which the project is located to design certain non-structural metal stud assemblies where indicated in the Drawings and as specifically indicated herein:

1. The following non-structural metal stud assemblies shall be Delegated Design items:

a. Gage of all metal studs, based on use, depth, and height.
b. Ceiling soffits and bulkheads.
c. Headers exceeding 6 feet in width, and headers supporting hanging items, door tracks, or similar.
d. Cantilevered partitions without 90-degree returns, or with runs exceeding 8 feet, or with casework or other construction hanging from the partitions.
e. All metal stud assemblies supporting cantilevered equipment or items such as countertop or lavatory brackets.
f. Other assemblies indicated.

2. Metal stud assembly design shall follow the finish and function design intent indicated in the Drawings, and shall only deviate in form or function if approved by the Architect.
3. Metal stud assemblies shall be designed to be self-supporting, including faming and all materials, accessories, and equipment attached therewith; shall resist dynamic and live loads imposed on the assemblies during intended use without undue vibration or wracking; and shall have deflection limited to a maximum of L/240 or more strict if necessary to keep finish materials from cracking or buckling.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: Not less than 20 gage, and as engineered by the General Contractor to meet the requirements in this section and for the design intent indicated.
b. Depth: As indicated on Drawings.

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: Not less than 20 gage, and as engineered by the General Contractor to meet the requirements in this section and for the design intent indicated.

1) Dimpled studs of lesser thickness that are equivalent in strength non-dimpled, 20 gage metal studs shall not be acceptable, and will be rejected.

b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. 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.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: As indicated on Drawings.

F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.

G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.

H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.

D. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.

    a. Minimum Base-Metal Thickness: As indicated on Drawings.
    b. Depth: As indicated on Drawings.

E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacings indicated.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows unless indicated otherwise on drawings:

a. Single layer application: 16 o.c.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

2. 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.

3. 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.

4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
5. 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 o.c.

D. 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 o.c.

3.5 INSTALLING 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] <Insert deflection limit>.

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. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 2216

SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 09 2216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected 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 recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 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 E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corp.
2. Georgia-Pacific Gypsum LLC.
3. Lafarge North America Inc.
4. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: As indicated on drawings.
2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: As indicated on drawings.
2. Long Edges: Tapered.

D. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

E. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: As indicated.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

G. Impact Resistant Gypsum Board:

1. Core: 5/8", Type X.
2. Long Edges: Tapered
3. Surface Abrasion: ASTM C 1629 Level 3
4. Indentation Resistance: ASTM C 1629 Level 1
5. Soft Body Impact Resistance: ASTM C 1629 Level 3
6. Hard Body Impact Resistance: ASTM C 1629 Level 3

2.4 SPECIALTY GYPSUM BOARD

A. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

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. Georgia-Pacific Gypsum LLC; DensArmour Plus.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

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 Corp.
b. Georgia-Pacific Gypsum LLC.
c. Lafarge North America Inc.
d. National Gypsum Company.
e. USG Corporation.

2. Core: 1/2 inch, regular type.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

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.; GlasRoc Sheathing.
b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond, e(2)XP.
d. USG Corporation; Securock Glass Mat Sheathing.

2. Core: 1/2 inch, regular type.

2.6 TRIM ACCESSORIES

A. Interior Trim:

1. Basis of Design Product: Subject to compliance with requirements, provide Structus; NO-COAT Structural Laminate Drywall Corner System
2. Material: Tapered co-polymer core with joint tape at inner surface and formulated surface paper on outer surface.
3. Shapes:

a. Outside 90
b. Inside 90
c. 5/8 inch "L" Trim.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

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.

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.
3. Fill Coat: For second coat, use drying-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

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. Pecora Corporation; AC-20 FTR.
b. USG Corporation; SHEETROCK Acoustical Sealant.

F. Thermal Insulation: As specified in Section 07 2100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 07 2100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. 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- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- 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. 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 recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. 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: As indicated on Drawings.
2. Type X: As indicated on Drawings.
3. Flexible Type: Apply in double layer at curved assemblies.
4. Ceiling Type: As indicated on Drawings.
5. Moisture- and Mold-Resistant Type: As indicated on Drawings.
6. Glass-Mat Interior 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.
b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: [Fasten base layers and face layers separately to supports with screws] [Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners].

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

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.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. U-Bead: Use at exposed panel edges.
5. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, 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 according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for acoustical tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
4. Level 5: Where indicated on Drawings.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

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.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

SECTION 09 3013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Glazed wall tile.
3. Thresholds.
4. Tile backing panels.
5. Crack isolation and waterproof membranes.

B. Related Sections:

1. Section 09 0561.13 "Moisture Vapor Emission Control" for application of a moisture vapor emission control system to floor substrate below floor coverings specified in this Section, if floor substrate moisture exceeds the requirements of the floor covering system.

1.2 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. Face Size: Actual tile size, excluding spacer lugs.

C. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required

2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch lengths.
4. Metal edge strips in 6-inch lengths.

1.5 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.

1.6 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.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of membranes and large format tile.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. 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 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.

1.9 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 tile of each type tile of each color or finish tile from single 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 crack isolation and waterproof membrane, except for sheet products, from manufacturer specifically recommended or approved by setting and grouting materials 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. Crack isolation membrane.

3. Cementitious backer units.

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.

2.3 TILE PRODUCTS

A. Porcelain Tile Type CT-1: Unglazed.

1. Basis-of-Design: Subject to compliance with requirements, provide Tile America; "Atlantic Stone", in manufacturer's pre-packaged "Pattern B32" comprised of a two tile module sizes indicated, or a comparable product by another manufacturer including, but not limited to, the following:

a. American Marazzi Tile, Inc.
b. American Olean; a division of Dal-Tile Corporation.
c. Crossville, Inc.
d. Daltile.
e. Florida Tile, Inc.
f. Florim USA.
g. Grupo Porcelanite.
h. Interceramic.
i. Iris US.
j. Seneca Tiles, Inc.

2. Face Size: Pre-packaged blend comprised of 33 percent 6 x 24 inch, and 67 percent 12 x 24 inch tile sizes.
3. Face Size Variation: Rectified.
4. Thickness: 10mm.
5. Face: Plain with square edges, matte texture.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
8. Grout Color: As selected by Architect from manufacturer's full range.

9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cap: Surface bullnose.
    b. Wainscot Cap: Surface bullnose.
    c. External Corners: Surface bullnose, module size.
    d. Internal Corners: Field-butted square corners.

B. Porcelain Tile Type BT-1: Unglazed.

1. Tile America; "Atlantic Stone", or a comparable product by another manufacturer including, but not limited to, the following:

    a. American Marazzi Tile, Inc.
    b. American Olean; a division of Dal-Tile Corporation.
    c. Crossville, Inc.
    d. Daltile.
    e. Florida Tile, Inc.
    f. Florim USA.
    g. Grupo Porcelanite.
    h. Interceramic.
    i. Iris US.
    j. Seneca Tiles, Inc.

2. Face Size: 6x24 inches.
3. Face Size Variation: Rectified.
4. Thickness: 10mm.
5. Face: Plain with square edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
8. Grout Color: As selected by Architect from manufacturer's full range.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cap: Surface bullnose.
    b. Wainscot Cap: Surface bullnose.
    c. External Corners: Surface bullnose.
    d. Internal Corners: Field-butted square corners.

C. Porcelain Tile Type CT-2: Glazed.

1. Basis-of-Design: Subject to compliance with requirements, provide DalTile; Linden Point line or a comparable product by another manufacturer including, but not limited to, the following:

    a. American Marazzi Tile, Inc.

b. American Olean; a division of Dal-Tile Corporation.
c. Crossville, Inc.
d. Florida Tile, Inc.
e. Florim USA.
f. Grupo Porcelanite.
g. Interceramic.
h. Iris US.
i. Seneca Tiles, Inc.

2. Face Size: 12x24.
3. Face Size Variation: Rectified.
4. Thickness: 3/8 inch.
5. Face: Slightly varying linear horizontal textured, with square edges, .
6. Appearance: Soft linear stone appearance with varying horizontal veining, exhibiting a high shade variation.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

a. Base Cap: Surface bullnose, module size 3x12 inches.
b. External Corners: Surface bullnose, module size 3x10 inches.
c. Bullnose Corners: Surface bullnose on two edges, 3x3 inches.
d. Internal Corners: Field-butted square corners.

D. Porcelain Tile Type CT-3: Glazed.

1. Basis-of-Design: Subject to compliance with requirements, provide DalTile; Linden Point line or a comparable product by another manufacturer including, but not limited to, the following:

a. American Marazzi Tile, Inc.
b. American Olean; a division of Dal-Tile Corporation.
c. Crossville, Inc.
d. Florida Tile, Inc.
e. Florim USA.
f. Grupo Porcelanite.
g. Interceramic.
h. Iris US.
i. Seneca Tiles, Inc.

2. Face Size: 2x2 inches, pre-matted in 12x24 inch sheets.
3. Face Size Variation: Rectified.
4. Thickness: 3/8 inch.
5. Face: Slightly varying linear horizontal textured, with square edges, .

6. Appearance: Soft linear stone appearance with varying horizontal veining, exhibiting a high shade variation.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cap: Surface bullnose, module size 3x12 inches.
    b. External Corners: Surface bullnose, module size 3x10 inches.
    c. Bullnose Corners: Surface bullnose on two edges, 3x3 inches.
    d. Internal Corners: Field-butted square corners.

E. Porcelain Tile Type CT-4: Glazed.

1. Basis-of-Design: Subject to compliance with requirements, provide DalTile; Linden Point line or a comparable product by another manufacturer including, but not limited to, the following:

    a. American Marazzi Tile, Inc.
    b. American Olean; a division of Dal-Tile Corporation.
    c. Crossville, Inc.
    d. Florida Tile, Inc.
    e. Florim USA.
    f. Grupo Porcelanite.
    g. Interceramic.
    h. Iris US.
    i. Seneca Tiles, Inc.

2. Face Size: 12x24 inches.
3. Face Size Variation: Rectified.
4. Thickness: 3/8 inch.
5. Face: Slightly varying linear horizontal textured, with square edges, .
6. Appearance: Soft linear stone appearance with varying horizontal veining, exhibiting a high shade variation.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cap: Surface bullnose, module size 3x12 inches.
    b. External Corners: Surface bullnose, module size 3x10 inches.
    c. Bullnose Corners: Surface bullnose on two edges, 3x3 inches.
    d. Internal Corners: Field-butted square corners.

F. Glazed Wall Tile Type CT-5:

1. Basis-of-Design: Subject to compliance with requirements, provide DalTile "Retrospace" line or a comparable product by another manufacturer including, but not limited to, the following:

    a. American Marazzi Tile, Inc.
    b. American Olean; a division of Dal-Tile Corporation.
    c. Grupo Porcelanite.
    d. Jeffrey Court Inc.
    e. Seneca Tiles, Inc.

2. Module Size: 3x6 inches.
3. Face Size Variation: Rectified.
4. Thickness: 1/4 inch.
5. Face: Slightly undulating, smooth, with cushion edges.
6. Finish: Bright, translucent glaze.
7. Tile Color and Pattern: As indicated by manufacturer's designations
8. Grout Color: As selected by Architect from manufacturer's full range.
9. Mounting:

    a. Unmounted, individual loose tiles.
    b. Pregrouted sheets of tiles are factory assembled and grouted with manufacturer's standard white silicone rubber.

10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.

    a. External Corners for Thinset Mortar Installations: Surface bullnose, same size as adjoining flat tile.
    b. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of according to ASTM C1353 or ASTM C241/C241M and with honed finish.

1. Description:

a. Uniform, fine- to medium-grained white stone with gray veining.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A, in maximum lengths available to minimize end-to-end butt joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C-Cure.
b. Custom Building Products.
c. FinPan, Inc.
d. Georgia-Pacific Gypsum LLC.
e. USG Corporation.

2. Thickness: 5/8 inch.

2.6 CRACK ISOLATION AND WATERPROOFING MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Crack Isolation and Waterproofing Membrane, Fluid-Applied: Liquid-latex rubber or elastomeric polymer.

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. Bostik, Inc.
b. C-Cure.
c. Custom Building Products.
d. Laticrete International, Inc.
e. MAPEI Corporation.

2.7 SETTING MATERIALS

A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

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. Boiardi Products Corporation; a QEP company.
    b. Bostik, Inc.
    c. C-Cure.
    d. Custom Building Products.
    e. H.B. Fuller Construction Products Inc. / TEC.
    f. Jamo Inc.
    g. Laticrete International, Inc.
    h. MAPEI Corporation.
    i. Sakrete; CRH Americas, Oldcastle APG.
    j. Siena Products; Omega.
    k. Southern Grouts & Mortars, Inc.
    l. Summitville Tiles, Inc.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

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. ARDEX Americas.
    b. C-Cure.
    c. Custom Building Products.
    d. H.B. Fuller Construction Products Inc. / TEC.
    e. Laticrete International, Inc.
    f. MAPEI Corporation.

2. Provide either prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site; or dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. High-Performance Tile Grout: ANSI A118.7.

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. ARDEX Americas.
    b. Boiardi Products Corporation; a QEP company.
    c. Bostik, Inc.
    d. C-Cure.
    e. Custom Building Products.
    f. H.B. Fuller Construction Products Inc. / TEC.
    g. Jamo Inc.
    h. Laticrete International, Inc.
    i. MAPEI Corporation.
    j. Sakrete; CRH Americas, Oldcastle APG.
    k. Southern Grouts & Mortars, Inc.
    l. Summitville Tiles, Inc.

2. Polymer Type: Either Ethylene vinyl acetate or acrylic additive in dry, redispersible form, prepackaged with other dry ingredients; or Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

C. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

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. Atlas Minerals & Chemicals, Inc.
    b. Boiardi Products Corporation; a QEP company.
    c. Bostik, Inc.
    d. C-Cure.
    e. Custom Building Products.
    f. H.B. Fuller Construction Products Inc. / TEC.
    g. Jamo Inc.
    h. Laticrete International, Inc.
    i. MAPEI Corporation.
    j. Merkrete; a Parex USA, Inc. brand.
    k. Sakrete; CRH Americas, Oldcastle APG.
    l. Sauereisen.
    m. Siena Products; Omega.
    n. Southern Grouts & Mortars, Inc.
    o. Summitville Tiles, Inc.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.9 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. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless steel, ASTM A276/A276M or ASTM A666, 300 Series exposed-edge material.

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. Blanke Corporation.
b. Ceramic Tool Company, Inc.
c. Schluter Systems L.P.

C. 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.

D. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.10 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 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. Test slab moisture and relative humidity are within allowable limits of Crack Isolation and Waterproof Membrane manufacturer. Use Anhydrous Calcium Chloride Test method for slab moisture content, and in situ probes for Relative Humidity Test.

    a. Install MVE-Control System, specified in Section 09 561.13 "Moisture Vapor Emission Control", to concrete slabs which have repeatedly failed Anhydrous Calcium Chloride Test and Relative Humidity Test.

4. 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.
5. 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 thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. 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 INSTALLATION OF CERAMIC TILE

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. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches or larger.
    c. 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. Ceramic Mosaic Tile: 1/8 inch.
2. Glazed Wall Tile: 1/16 inch.
3. Porcelain Tile: 1/4 inch.

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.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Do not extend crack isolation and waterproof membrane under thresholds set in standard dry-set modified dry-set or improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on crack isolation and waterproof membrane with elastomeric sealant.

K. Metal Edge Strips: Install at locations indicated, and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

L. 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 INSTALLATION OF TILE BACKING PANELS

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 INSTALLATION OF CRACK ISOLATION AND WATERPROOF MEMBRANES

A. Install crack isolation and waterproof membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation and waterproof membrane to cure 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. TCNA F125-Full: Thinset mortar on crack isolation and waterproof membrane.

a. Ceramic Tile Type: CT-1, CT-2, and CT-3.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout:

1) Dry Locations: High-performance sanded grout.
2) Wet Locations: Water-cleanable epoxy grout.

B. Interior Wall Installations, Masonry or Concrete:

1. TCNA W202: Thinset mortar.

a. Ceramic Tile Type: CT-5.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance unsanded grout.

2. TCNA W202: Thinset mortar.

a. Ceramic Tile Type: CT-1, BT-1, CT-2, CT-3, and CT-4.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance sanded grout.

C. Interior Wall Installations, Wood or Metal Studs or Furring:

1. TCNA W244C or TCNA W244F: Thinset mortar on cementitious backer units.

    a. Ceramic Tile Type: CT-1, BT-1, CT-2, CT-3, and CT-4.
    b. Thinset Mortar: Improved modified dry-set mortar.
    c. Grout: High-performance sanded grout.

2. TCNA W244C or TCNA W244F: Thinset mortar on cementitious backer units.

    a. Ceramic Tile Type: CT-5.
    b. Thinset Mortar: Improved modified dry-set mortar.
    c. Grout: High-performance unsanded grout.

D. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:

1. TCNA B412: Thinset mortar on cementitious backer units.

    a. Ceramic Tile Type: As scheduled.
    b. Thinset Mortar: Improved modified dry-set mortar.
    c. Grout: Water-cleanable epoxy grout.

END OF SECTION 09 3013

SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. 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.

2.2 ACOUSTICAL PANELS CLG-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; Ultima 15/16" Square Lay-In 1910, or comparable product by one of the following:

1. American Gypsum.
2. CertainTeed Corporation.
3. USG Ceiling Solutions.

B. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E 1264.

C. Classification: Type IV, Form 2, Pattern E.

D. Color: White.

E. Light Reflectance (LR): 0.88.

F. Ceiling Attenuation Class (CAC): 35 minimum.

G. Noise Reduction Coefficient (NRC): 0.75.

H. Edge/Joint Detail: Square.

I. Thickness: 3/4 inch.

J. Modular Size: 24 by 24 inches.

2.3 ACOUSTICAL PANELS CLG-8

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; Optima PB Health Zone 3114PB, comparable product by one of the following:

B. American Gypsum.

C. CertainTeed Corporation.

D. USG Ceiling Solutions.

E. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E 1264.

F. Classification: Type XII, Form 2, Pattern E, Fire Class A.

G. Color: White.

H. Light Reflectance (LR): 0.86.

I. Noise Reduction Coefficient (NRC): 0.95.

J. Edge/Joint Detail: Square.

K. Thickness: 1 inch.

L. Modular Size: 24 by 24 inches.

2.4 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; Prelude XL 15/16" Exposed Tee System, or comparable product by the same manufacturer as the acoustical ceiling panel.

B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M.

C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted white.

2.5 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.

B. Hold-Down Clips: Manufacturer's standard hold-down.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Basis-of-Design Product: Subject to compliance with requirements, provide matching products by same manufacturer as Metal Suspension System. Materials from a different manufacturer are not acceptable.

B. 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.

PART 3 - EXECUTION

3.1 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.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.

B. 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. Do not use exposed fasteners, including pop rivets, on moldings and trim.
3. Arrange directionally patterned acoustical panels as follows:

    a. Install panels with pattern running parallel.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform inspections.

1. Periodically inspect during the installation of suspended ceiling grids according to ASCE/SEI 7.

2. Repair, or remove and replace, components of ceiling systems that do not pass test requirements.

END OF SECTION 09 5113

SECTION 09 5133 - ACOUSTICAL METAL PAN 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:

1. Acoustical metal pans and associated suspension system for interior ceilings.

B. Related Requirements:

1. Section 09 5113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
2. Section 09 5423 "Linear Metal Ceilings."

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. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include procedure for cutting metal pans.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.
2. Sound Absorber: Sample of each type matching size of Sample metal pan.

C. Delegated-Design Submittal: For design of seismic restraints and attachment devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each acoustical metal pan ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Evaluation Reports: For each acoustical metal pan ceiling suspension system.

D. 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 that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Metal Pans with Sound Absorber: Full-size units equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each grid, exposed molding, and trim equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical metal pans, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle acoustical metal pans, suspension-system components, and accessories carefully to avoid damaging units and finishes in any way.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design seismic restraints and attachment devices.

B. 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: Comply with ASTM E1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL METAL PANS, GENERAL

A. Source Limitations: Obtain each type of acoustical metal ceiling pan and supporting suspension system from single source from single manufacturer.

B. Acoustical Panel Standard: Provide manufacturer's standard pans of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E795.

C. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Aluminum Sheet: Rolled aluminum sheet, complying with ASTM B209; alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E84.

1. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.

E. Adhesive: Manufacturer's standard nonflammable adhesive for sound-absorbent fabric .

2.3 ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING CLG-2

A. Basis-of-Design: Subject to compliance with requirements, provide USG Corporation; Panz Metal Panels of types indicated, or comparable product by one of the following:

1. American Decorative Ceilings (ADC).
2. Armstrong World Industries, Inc.
3. Ceilings Plus.
4. Gage Corporation International (The).
5. Hunter Douglas Architectural Products, Inc.
6. Steel Ceilings Inc.

B. Classification: Units complying with ASTM E1264 for Type VII, perforated aluminum facing (pan) with mineral- or glass-fiber-base backing .

1. Pattern: Pattern C (perforated, small holes) regularly spaced, with uniform perforations of dimension, holes per square foot or inch, and percent open area as specified by product designation.
2. Pattern: Perforated, orund holes in a straight configuration.

C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.

1. Lay-in Pans: Formed to set in exposed suspension grid.

D. Pan Thickness: Not less than 0.019 inch .

E. Pan Edge Detail: Square.

F. Pan Size: 24 by 24 inches .

G. Pan Face Finish: Painted in color selected from manufacturer's full range.

H. Light Reflectance Coefficient: Not less than 0.50.

I. NRC: Not less than 0.65.

J. Ceiling Attenuation Class: Not less than 30.

2.4 DIRECT-HUNG, STANDARD-GRID, METAL SUSPENSION SYSTEM FOR ACOUSTICAL METAL PAN CEILING CLG-2

A. Basis-of-Design: Subject to compliance with requirements, provide USG Corporation; 15/16: USG DX Suspension System, or comparable productr by identical manufacturer as metal ceiling panels.

B. Suspension System: For lay-in pans.

C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A653/A653M, G30 coating designation, with prefinished, cold-rolled, 15/16-inch- wide, sheet metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Cap Finish: Painted in color as selected from manufacturer's full range .

2.5 ACOUSTICAL SEALANT

A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are 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.

2.7 ALUMINUM FINISHES

A. Color-Coated Finish: Manufacturer's standard powder-coat baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan 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 metal pan ceilings.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and coordination drawings.

3.3 INSTALLATION

A. General: Install acoustical metal pan ceiling assemblies to comply with ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. 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 either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that do not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

6. 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.
7. Do not attach hangers to steel deck tabs.
8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.

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 o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet. Cut and treat edges to comply with manufacturer's written instructions.

F. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with manufacturer's installation tolerances.

1. For lay-in, square-edge pans, install pans with edges fully hidden from view by flanges of suspension-system runners and moldings.
2. For pans, position pans according to manufacturer's written instructions.
3. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
4. Fit adjoining units to form flush, tight joints.
5. Install sound-absorbent fabric layers in, and bond to, perforated metal pans.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Seismic design compliance.

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 metal panel ceiling hangers, anchors, and fasteners in successive stages. Do not proceed with installations of acoustical metal panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed.

a. Within each test area, testing agency selects one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and tests them for 200 lbf of tension; it also selects one of every two postinstalled anchors used to attach bracing wires to concrete and tests them for 440 lbf of tension.
b. When tested fasteners and anchors do not comply with requirements, testing agency tests those fasteners and anchors not previously tested until 20 pass consecutively and then resumes initial testing frequency.

D. Acoustical metal panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings, after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 09 5133

SECTION 09 5423 - LINEAR METAL 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:

1. Linear metal ceilings.

1.3 COORDINATION

A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each type, color, and finish specified, 12 inches long in size.

C. Samples for Verification: For the following products:

1. Linear Metal Pans: 12 inches long by full-width Samples of each type, color, and finish and a 12-inch- long spliced section.
2. Suspension-System Members: 12-inch- long Sample of each type.
3. Exposed Molding and Trim: 12-inch- long Samples of each type, color, and finish.
4. Filler Strips: 12-inch- long Samples of each type, color, and finish.
5. Sound Absorbers: 12 inches long by full width.
6. End Caps: Full size.

D. Delegated Design Submittal: For design of seismic restraints and attachment devices.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each linear metal ceiling, for tests performed by a qualified testing agency.

C. Evaluation Reports: For linear-metal-ceiling framing systems.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Linear-Metal-Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by National Voluntary Laboratory Accreditation Program for testing indicated.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver ceiling components and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle ceiling components and accessories in a manner that prevents damage.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements" to design seismic restraints and attachment devices.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

C. Seismic Criteria: Provide linear metal ceilings designed and installed to withstand the effects of earthquake motions in accordance with ASCE/SEI 7 and requirements of authorities having jurisdiction.

2.2 LINEAR METAL CEILING CLG-4

A. Pans and Suspension System:

1. Basis-of-Design: Subject to compliance with requirements, provide Arrmstrong Ceiling & Wall Solutions; Metalworks Linear - Classics Planks, 6" wide, 7160, M1 unperforated, color FXWN "Effects Walnut", or comparable product by one of the following:

a. American Decorative Ceilings (ADC).
b. Hunter Douglas Architectural Products, Inc.
c. Rockfon (Rockwool International).
d. USG Corporation.

B. Metal Pans: Complying with ASTM E1264 for Type XX and formed to snap on to carriers securely, without separate fasteners.

1. Surface-Burning Characteristics: For metal-pan assemblies, including backings, determined by testing in accordance with ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

2. Metal: Electrolytic zinc-coated steel sheet, ASTM A879/A879M, 04Z coating; surface treatment as recommended by finish manufacturer for type of use and painted finish indicated.
3. Form: Nonperforated.
4. Noise Reduction Coefficient (NRC) Rating: Not less than 0.70 when tested in accordance with ASTM C423.
5. Backing: Manufacturer's standard to provide NRC rating indicated for perforation pattern indicated.
6. Pan Thickness: Not less than 0.020 inch.
7. Pan Edge Detail: Square.
8. Pan Width: 6-inch module width and 5-1/4-inch face width.
9. Pan Depth: 5/8 inch.
10. Metal-Pan Finish: Protected on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping and as follows:

a. Laminated-Film Finish: Provide manufacturer's standard film permanently bonded to metal pan with adhesive.

1) Color and Pattern: Walnut veneer effect, as indicated by manufacturer's finish designation.

C. Pan Splices: Formed for snap fit into butt-cut pans, 4 inches long.

1. Finish: Matching pan.

D. End Caps: Manufacturer's standard material fabricated to fit and conceal exposed ends of pans.

1. Finish: Matching pan.

E. Filler Strips: Manufacturer's standard, fabricated to close voids between pans.

1. Type: Recessed.
2. Finish: Matching pan.

F. Moldings and Trim: Manufacturer's standard for exposed members, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

G. Carrier Suspension System: Manufacturer's standard complying with requirements in ASTM C635/C635M for applications indicated; complete with carriers, splice sections, stabilizing components, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

1. Material: ASTM A879/A879M, electrolytic zinc-coated, cold-rolled steel, 08Z coating designation.
2. Structural Classification: Heavy-duty system.
3. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
4. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers.
5. Carrier Splices: Same metal, profile, and finish as for carriers.
6. Carrier Finish: Flat black.

2.3 LINEAR METAL CEILING CLG-5

A. Pans and Suspension System:

1. Basis-of-Design: Subject to compliance with requirements, provide Arrmstrong Ceiling & Wall Solutions; Metalworks Linear - Syncro Planks, 4" wide, 8223W04, color FXWN "Effects Walnut", or comparable product by one of the following:

   a. American Decorative Ceilings (ADC).
   b. Hunter Douglas Architectural Products, Inc.
   c. Rockfon (Rockwool International).
   d. USG Corporation.

B. Metal Pans: Complying with ASTM E1264 for Type XX and formed to snap on to carriers securely, without separate fasteners.

1. Surface-Burning Characteristics: For metal-pan assemblies, including backings, determined by testing in accordance with ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 50 or less.

2. Metal: Electrolytic zinc-coated steel sheet, ASTM A879/A879M, 04Z coating; surface treatment as recommended by finish manufacturer for type of use and painted finish indicated.
3. Form: Nonperforated.
4. Noise Reduction Coefficient (NRC) Rating: Not less than 0.70 when tested in accordance with ASTM C423.

5. Backing: Manufacturer's standard to provide NRC rating indicated for perforation pattern indicated.
6. Pan Thickness: Not less than 0.020 inch.
7. Pan Edge Detail: Square.
8. Pan Width: 4 inch actual face width, installed without reveals.
9. Pan Depth: 1 inch.
10. Metal-Pan Finish: Protected on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping and as follows:

    a. Laminated-Film Finish: Provide manufacturer's standard film permanently bonded to metal pan with adhesive.

        1) Color and Pattern: Walnut veneer effect, as indicated by manufacturer's finish designation.

C. Pan Splices: Formed for snap fit into butt-cut pans, 4 inches long.

1. Finish: Matching pan.

D. End Caps: Manufacturer's standard material fabricated to fit and conceal exposed ends of pans.

1. Finish: Matching pan.

E. Moldings and Trim: Manufacturer's standard for exposed members, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

F. Carrier Suspension System: Manufacturer's standard complying with requirements in ASTM C635/C635M for applications indicated; complete with carriers, splice sections, stabilizing components, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

1. Material: ASTM A879/A879M, electrolytic zinc-coated, cold-rolled steel, 08Z coating designation.
2. Structural Classification: Heavy-duty system.
3. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
4. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers.
5. Carrier Splices: Same metal, profile, and finish as for carriers.
6. Carrier Finish: Flat black.

2.4 CARRIER-SYSTEM HANGERS, BRACES, AND TIES

A. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.

B. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provides not less than 0.106-inch- diameter wire.

C. Seismic Struts: Suspension-system manufacturer's standard compression struts designed to accommodate seismic forces.

2.5 ACCESSORIES

A. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors permitting upward or downward opening.

1. Size: 24 inches square.

B. Air-Distribution Devices: Where indicated on Drawings, provide independently suspended air-distribution devices that are relocatable and adjustable from below finished ceiling, that do not interrupt ceiling components, and that are fully concealed by and integrated with ceiling system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal 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 linear metal ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of linear metal pans.

1. Balance border widths at opposite edges of each ceiling.
2. Avoid using less-than-half-width pans at borders.

3.3 INSTALLATION

A. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. 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 in 3 inches. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts or postinstalled mechanical or adhesive anchors that extend through forms into concrete.
6. 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.
7. Do not attach hangers to steel deck tabs.
8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.

1. Screw attach moldings to substrate at intervals of not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension-system carriers so they are aligned and securely interlocked with one another.

1. Install stabilizer channels, tees, and bars at regular intervals to stabilize carriers and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated.
2. Remove and replace dented, bent, or kinked members.

E. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness.

F. Install linear metal pans in coordination with suspension system and exposed moldings and trim.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated on Drawings.
2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.

    a. Install pans with butt joints staggered a minimum of 12 inches using internal pan splices.

3. Install directionally textured or patterned metal pans in directions indicated.
4. Where metal pan ends are visible, install end caps unless trim is indicated.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Suspended ceiling system.
2. Hangers, anchors, and fasteners.

B. Tests and Inspections: Testing and inspecting of completed installations of linear metal ceiling hangers, anchors, and fasteners shall take place in successive stages, in test areas and using methods as follows. Do not proceed with installations of linear metal ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Test Areas: Test installation of ceiling suspension systems on each floor when installation has reached 20 percent completion but before pans have been installed.

    a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
    b. 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.

C. Linear metal ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings, after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 09 5423

SECTION 09 6513 - 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

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 for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, 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. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base BT-3 and BT-4:

1. Basis-of-Design: Subject to compliance with requirements, provide Tarkett; Johnsonite Resilient Wall Base Traditional DC-XX, or comparable product by one of the following:

a. Allstate Rubber Corp.; Stoler Industries.
b. Armstrong World Industries, Inc.
c. Mondo Rubber International, Inc.
d. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Minimum Thickness: 0.125 inch.

4. Height:

a. BT-3: 4 inches.
b. BT-4: 6 inches.

5. Lengths: Coils in manufacturer's standard length.
6. Outside Corners: Job formed.
7. Inside Corners: Job formed.
8. Finish: As selected by Architect from manufacturer's full range.
9. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 09 6513

SECTION 09 6519 - 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. Solid vinyl floor tile.

B. Related Sections:

1. Section 09 0561.13 "Moisture Vapor Emission Control" for application of a moisture vapor emission control system to floor substrate below floor coverings specified in this Section, if floor substrate moisture exceeds the requirements of the floor covering system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Full-size units of each color, texture, and pattern of floor tile required.

C. Samples for Initial Selection: For each type of floor tile indicated.

D. 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, 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. 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: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

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 or more than 95 deg F, in spaces to receive floor tile during the following 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 SOLID VINYL FLOOR TILE LVT-1

A. Basis-of-Design: Subject to compliance with requirement, provide Armstrong World Industries, Inc.; Natural Creations with Diamond10 Technology Luxury Flooring, ArborArt Line, or comparable product by one of the following:

1. Altro Group; .
2. American Biltrite; .
3. Congoleum Corporation; .
4. Ecomoso, Centiva Vinyl Flooring; .
5. Johnsonite; A Tarkett Company; .
6. Mannington Mills, Inc.; .
7. Patcraft; a division of Shaw Industries, Inc; .
8. Shaw Contract Group; a Berkshire Hathaway company; .
9. TOLI International; .

B. Tile Standard: ASTM F 1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: B, Embossed Surface.

C. Thickness: 0.125 inch.

1. Wear Layer Thickness: Not less than 0.020 inch.

D. Size: 6 by 48 inches.

E. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by 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.

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 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..

5. Moisture Vapor Emission Control: Install MVE-Control System, specified in Section 09 561.13 "Moisture Vapor Emission Control", to concrete slabs which have repeatedly failed Anhydrous Calcium Chloride Test.

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 floor tiles until materials are the same temperature as 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.

E. 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.

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.

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 installation 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 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. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from 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. Cover floor tile until Substantial Completion.

END OF SECTION 09 6519

SECTION 09 6536 - STATIC-CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Static-control, vinyl composition floor tile.

B. Related Requirements:

1. Section 09 0561.13 "Moisture Vapor Emission Control" for application of a moisture vapor emission control system to floor substrate below floor coverings specified in this Section, if floor substrate moisture exceeds the requirements of the floor covering system.
2. Section 09 6513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to static-control resilient flooring including, but not limited to, the following:

a. Examination and preparation of substrates to receive static-control resilient flooring.
b. Installation techniques required for specified products.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of static-control resilient flooring. Include floor-covering layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show grounding locations of grounding strips and connections.

C. Samples: For each type of static-control resilient flooring and in each color, pattern, and texture required, in manufacturer's standard size, but not less than 6 by 9 inches.

D. Samples for Initial Selection: For each exposed static-control resilient flooring product, in manufacturer's standard size.

E. Product Schedule: For static-control resilient flooring. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For static-control resilient flooring, for tests performed by a qualified testing agency.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of static-control resilient flooring to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes, or fraction thereof, of each type, color, and pattern of floor tile installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in installation techniques required by manufacturer for specified static-control resilient flooring.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required for specified products.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended in writing by manufacturer, but not less than 50 deg F or more than 90 deg F.

1. Floor Tile: Store on flat surfaces.
2. Sheet Floor Covering: Store rolls upright.

1.10 PROJECT CONDITIONS

A. Maintain ambient temperatures in spaces to receive static-control resilient flooring within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, during the following time periods:

1. Period recommended in writing by manufacturer before installation.
2. During installation.
3. Period recommended in writing by manufacturer after installation.

B. Until Substantial Completion, maintain ambient temperatures in installation areas within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during static-control resilient flooring installation.

D. Close spaces to traffic for period recommended in writing by manufacturer after static-control resilient flooring installation.

E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 STATIC-CONTROL, VINYL COMPOSITION FLOOR TILE VCT-1

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. Armstrong World Industries, Inc.; Excelon SDT Static Control Flooring

B. Source Limitations: Obtain floor tile from single source from single manufacturer.

C. Static-Control Properties: As determined by testing identical products in accordance with test method indicated by an independent testing and inspecting agency.

1. Electrical Resistance:

    a. Material: Point-to-point and point-to-ground resistances between 1,000,000 ohms and 1,000,000,000 ohms when tested in accordance with ASTM F150.
    b. Material in Combination with a Person: Average resistance of 448,000,000 ohms when tested in accordance with ESD STM97.1.

2. Static Generation: When tested in accordance with ESD STM97.2, an average of less than 30 V when tested at 12 percent relative humidity with static-control footwear.
3. Static Decay: 1000 to 100 V in maximum of 0.2 seconds at 12 percent relative humidity when tested in accordance with manufacturer's standard test protocol using an operator wearing static-control footwear and a static decay meter.

D. Construction: ASTM F1066 Class 2, vinyl composition floor tile, through pattern.

E. Thickness: 1/8 inch.

F. Size: 12 by 12 inches.

G. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.

C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.

D. Floor Polish: Provide protective, static-control liquid floor polish products recommended in writing by floor-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with installation or static-control characteristics of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates in accordance with manufacturer's written instructions to ensure successful installation of static-control resilient flooring and electrical continuity of floor-covering systems.

B. Concrete Substrates: Prepare in accordance with ASTM F710.

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 floor-covering 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 in writing by manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer.
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 spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

5. Moisture Vapor Emission Control: Install MVE-Control System, specified in Section 09 561.13 "Moisture Vapor Emission Control", to concrete slabs which have repeatedly failed Anhydrous Calcium Chloride Test.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.

1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

3.3 INSTALLATION, GENERAL

A. Install static-control resilient flooring in accordance with manufacturer's written instructions.

B. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.

1. For adhesively installed flooring, embed grounding strips in static-control adhesive.

C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

1. Extend static-control resilient flooring below built-in items and permanent, but movable, items that allow for a flexible layout where indicated on Drawings.

D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings.

E. Extend static-control resilient flooring to center of door openings where flooring or color transitions occur.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install static-control resilient flooring on covers for telephone and electrical ducts, and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of static-control resilient flooring installed on covers. Tightly adhere static-control resilient flooring edges to substrates that abut covers and to cover perimeters.

H. Adhesive Installation: Adhere static-control resilient flooring to substrates using a full spread of static-control 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 INSTALLATION OF FLOOR TILE

A. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.

1. Lay floor tiles square with room axis.

B. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay vinyl composition floor tiles with grain direction alternating in adjacent floor tiles (basket-weave pattern).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring in accordance with ASTM F150 for compliance with requirements.

1. Arrange for testing after the following:

a. Static-control adhesives have fully cured.
b. Static-control resilient flooring has stabilized to ambient conditions.
c. Ground connections are completed.

2. Arrange for testing of static-control resilient flooring after performing floor polish procedures.

B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

B. Perform the following operations immediately after completing static-control resilient flooring:

1. Remove static-control adhesive from exposed surfaces.
2. Remove dirt and blemishes from exposed surfaces.
3. Sweep and vacuum surfaces thoroughly.
4. Damp-mop surfaces to remove marks and soil.

C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

1. Do not wax static-control resilient flooring.

2. If recommended in writing by manufacturer, apply protective static-control floor polish formulated to maintain or enhance floor covering's electrical properties. Before polishing, do the following:

    a. Ensure that static-control resilient flooring surfaces are free from soil, static-control adhesive, and surface blemishes.
    b. Verify that both floor polish and its application method are approved by manufacturer and that floor polish will not leave an insulating film that reduces static-control resilient flooring's effectiveness for static control.

D. Cover static-control resilient flooring and protect from rolling loads until Substantial Completion.

END OF SECTION 09 6536

SECTION 09 6623 RESILIENT RUBBER ATHLETIC 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. Resilient (rubber) Athletic Flooring.

B. Related Sections:

1. Section 09 0561.13 "Moisture Vapor Emission Control" for application of a moisture vapor emission control system to floor substrate below floor coverings specified in this Section, if floor substrate moisture exceeds the requirements of the floor covering system.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 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 Johnsonite, but not less than 55 deg F or more than 85 deg F.

1.5 PROJECT CONDITIONS

A. Install resilient products after other finishing operations, including painting, have been completed.

B. Maintain ambient temperatures within range recommended by Johnsonite, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 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.

C. Maintain the ambient relative humidity between 40% and 60% during installation.

D. Until Substantial Completion, maintain ambient temperatures within range recommended by Johnsonite, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

PART 2 - PRODUCTS

2.1 RESILIENT ATHLETIC FLOORING RT-1

A. Basis-of-Design: Subject to compliance with requirements, provide Johnsonite; REPLAY Commotion Square Edge Glue-Down Tile Resilient Rubber Athletic Tile Flooring, or a comparable product by one of the following:

1. Allied Products.
2. Amarco Products.
3. Ecore.
4. Kiefer USA.
5. Mondo.
6. Tarkett.

B. Physical characteristics:

1. Manufactured from a composition of recycled truck tire crumb rubber encapsulated in a urethane binder.
2. Overall thickness: 3/8" (9.5 mm).
3. Tile texture and appearance: Hammered, Textured, with a uniform, speckled appearance comprised of a combination of black crumb rubber and a single color crumb rubber.
4. Color: as selected by Architect from manufacturer's full range.
5. Tile style and size: Square Edge (glue down) 24" X 24" (61 cm X 61 cm)
6. ASTM D 2240 Standard Test Method for Rubber Property-Durometer Hardness: 65 Shore A.
7. ASTM D 2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring or 0.6 or greater.
8. ASTM F 970, Standard Test Method for Static Load Limit - passes 250 PSI.
9. ASTM D 3389 Standard Test Method for Coated Fabrics Abrasion Resistance: < 1.00 gram weight loss.

10. ASTM D 2859 Standard Test Method for Ignition Characteristics of Finished Floor Covering Materials (Pill Test): passes with greater than 1" of un-charred area.
11. Contains 92% post-consumer recycled content .
12. SCS FloorScore Certified.
13. Phthalate, chlorine and halogen-free.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation.

B. Adhesives: As recommended by Johnsonite to meet site conditions.

1. Resilient Rubber Athletic Flooring (For glue down tile only).

a. Johnsonite 965 Flooring and Tread Adhesive

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Verify that slab moisture content and relative humidity are within manufacturer's requirements.

1. Install MVE-Control System, specified in Section 09 561.13 "Moisture Vapor Emission Control", to concrete slabs which have repeatedly failed slab moisture and relative humidity tests.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of Resilient Athletic Flooring.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate paint, coatings and other substances that are incompatible with adhesives or contain soap, wax, oil, solvents, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Mechanically remove contamination on the substrate that may cause damage to the resilient athletic flooring material. Permanent and non-permanent markers, pens, crayons, paint, etc., must not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.
4. Prepare Substrates according to ASTM F 710 including the following:

    a. For glue down tile:

        1) Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
        2) Perform anhydrous calcium chloride test, ASTM F 1869. Results must not exceed 5 lbs. Moisture Vapor Emission Rate per 1,000 sq. ft. in 24 hours.
        3) A pH test for alkalinity must be conducted. Results should range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation must not proceed until the problem has been corrected.
        4) Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

B. Fill cracks, holes, depressions and irregularities in the substrate with Portland cement based underlayment leveling and patching compound recommended by flooring manufacturer.

C. Remove bumps and ridges to produce a uniform and smooth substrate.

D. Floor covering shall not be installed over expansion joints.

E. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT ATHLETIC FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient athletic flooring.

B. Resilient Athletic Rubber Tile Flooring:

1. Install with adhesive appropriate for substrate, and follow adhesive label for proper use.
2. Do not Quarter Turn tile.
3. Roll the flooring in both directions using a 100 pound three-section roller.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

1. No traffic for 24 hours after installation.
2. No heavy traffic, rolling loads, or furniture placement for 72 hours after installation.

D. Wait 72 hours after installation before performing initial cleaning

E. A regular maintenance program must be started after the initial cleaning.

END OF SECTION 09 6248

SECTION 09 6723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes resinous flooring 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. Samples: For each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERORMANCE REQUIREMENTS

A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flammability: Self-extinguishing according to ASTM D 635.

2.2 RESINOUS FLOORING RES-1 AND RES-2

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF UCRETE HP/F or comparable product by one of the following:

a. Dur-A-Flex, Inc.

B. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Orange-peel texture.
3. Overall System Thickness: 1/4 inch.

C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

E. Body Coats:

1. Resin: Polyurethane.
2. Application Method: Troweled or screeded.
3. Number of Coats: One.
4. Thickness of Coats: 1/8 to 3/16 inches.

5. Aggregates: Colored quartz (ceramic-coated silica).

F. Topcoat: MasterTop SRS 71TC Clear MMA.

1. Resin: Methyl-Methacrylate, self-leveling.
2. Type: Clear.
3. Number of Coats: Two.
4. Thickness of Coats: 5 mils.
5. Finish: Matte Gloss. To be selected by Architect during shop drawing phase of project.

G. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 8,128 psi minimum according to ASTM C 579.
2. Tensile Strength: 880 psi minimum according to ASTM C 307.
3. Water Absorption: less than 0.1% percent maximum according to ASTM C 413.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions. Round internal and external corners.

1. Integral Cove Base: 4 inches high.

D. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.

E. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

F. Protect resinous flooring from damage and wear during the remainder of construction period.

END OF SECTION 09 6723

SECTION 09 6813 - 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:

1. Modular carpet tile.

B. Related Requirements:

1. Section 02 4119 "Selective Demolition" for removing existing floor coverings.
2. Section 09 0561.13 "Moisture Vapor Emission Control" for application of a moisture vapor emission control system to floor substrate below floor coverings specified in this Section, if floor substrate moisture exceeds the requirements of the floor covering system.
3. Section 09 6513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation 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. Samples: 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- long Samples.

C. Samples for Initial Selection: For each type of carpet tile.

1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

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..

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Master II certification level.

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. 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. Comply with the Carpet and Rug Institute's CRI 104.

1.10 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 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, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: Lifetime of installation.

PART 2 - PRODUCTS

2.1 CARPET TILE CPT-1

A. Basis-of-Design: Subject to compliance with requirements, provide Mohawk Group; GT419 Side Stripe Tile, color as indicated, or a comparable product by one of the following:

1. Bentley Prince Street, Inc.
2. Interface, LLC.
3. Mannington Mills, Inc.
4. Patcraft; a division of Shaw Industries, Inc.
5. Shaw Contract Group; a Berkshire Hathaway company.
6. Tandus; a Tarkett company.

B. Color: As indicated by manufacturer's designations.

C. Pattern: Multi-color, random linear stripe.

D. Fiber Content: 100 percent nylon 6, 6 .

E. Fiber Type: Duracolor Tricolor Premium Nylon.

F. Pile Characteristic: Tufted, Textured Patterned Loop pile.

G. Density: 6,000 oz./cu. yd..

H. Stitches: 12.4 per inch.

I. Gage: 1/12 (47.00 rows per 10 cm).

J. Tufted Pile Weight: 17.0 oz. per sq. yd.

K. Primary Backing/Backcoating: Manufacturer's standard composite materials .

L. Secondary Backing: Manufacturer's standard material.

M. Backing System: EcoFlex NXT.

N. Size: 24 by 24 inches.

O. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

P. Performance Characteristics:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D7330.
2. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.
3. Tuft Bind: Not less than 5 lbf according to ASTM D1335.
4. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
5. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
7. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
8. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 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 03 3000 "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., 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 F1869. 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, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

2. Moisture Vapor Emission Control: Install MVE-Control System, specified in Section 09 561.13 "Moisture Vapor Emission Control", to concrete slabs which have repeatedly failed Anhydrous Calcium Chloride Test and Relative Humidity Test.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

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 wide or wider, and protrusions more than 1/32 inch 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. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

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 the Carpet and Rug Institute's CRI 104, Section 13.7.

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 09 6813

SECTION 09 7813 – METAL INTERIOR WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Porcelain enameled steel faced panel with high density fiberboard (HDF) core and aluminum backer, and associated accessories and trim.

1.2 RELATED SECTIONS

A. Section 09 2900, “Gypsum Board”.

1.3 SUBMITTALS

A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:

1. Product Brochure
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.

B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.

C. Selection Samples: Submit manufacturer’s standard color pattern selection samples representing manufacturer's full range of available colors and patterns.

D. Exposed Molding and Trim: Provide samples of each type, finish, and color.

1.4 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:

1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)

a. Wall Required Rating – Class A.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials factory packaged on strong pallets.

B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Building is to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work

B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.

1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.7 WARRANTY

A. Furnish one year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN PRODUCTS

A. Subject to compliance with requirements, provide products indicated as manufactured by Marlite, or comparable products by another manufacturer.

B. Metal Interior Wall Panel SFRP-1:

1. Basis-of-Design: a3 CeramicSteel Architectural Panels.
2. Composition: ceramic steel surface laminated to High Density Fiberboard (HDF) core, with aluminum backer.
3. Finish: As selected by Architect from manufacturer's full range.
4. Dimensions:

a. Thickness: .250"
b. Width: Panels not less than 47¾" actual.

c. Length: Panels available in lengths not less than 119 ¾" actual, but panels of lesser length may be provided, granted they yield the fabricated panel dimensions and joint locations indicated.

5. Tolerance:

a. Length and Width: +/-1/8 " (3.175mm)
b. Square: Not to exceed 1/8 " for 8 foot panels or 5/32 " (3.96mm) for 10 foot panels

C. Properties: Resistant to chemicals, scratch, bacteria, fire, graffiti and stain.

1. ASTM D 3363 – Hardness, greater than 9H.
2. ASTM C 501 – Wear Resistance, 0.1 g maximum.
3. ASTM D 2244 – Color Tolerance, comply with ASTM D 2244.
4. ASTM D 2244 – Reflectance, Y-value up to 93%.
5. ISO 15695 – 7 N minimum.
6. ISO 28722 – Graffiti Resistance, no color or gloss changes after cleaning.
7. ISO 4532 – Impact Resistance, no damage over 2mm after 24 hours (20 N load).
8. ISO 4892 – UV Resistance, comply with ISO 4892.
9. ISO 28706-1 – Cold Acid Resistance, Class A minimum.
10. ISO 28706-2 – Boiling Acid Resistance, 18.5 g/m2 maximum.
11. ASTM D523 – Orange Peel (Specular Gloss), comply with ASTM D523.
12. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials, Flame spread 0, Smoke Developed 75, Class A rating.

D. Back Surface: Smooth Aluminum backer.

E. Front Finish: As Indicated.

F. Surface: Standard Matte (approx. 30% Gloss),

2.2 MOLDINGS

A. Aluminum Trim: Heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.

1. Profiles :

a. FC568 Square Channel Division Designer Trim, 8' length
b. 565 Division Trim, 8' length
c. 551 Inside Corner, 8' length
d. 560 Outside Corner, 8' length
e. 570 Edge, 8' length

2. Color: As selected by Architect from manufacturer's available colors and finishes.

2.3 ACCESSORIES

A. Adhesive: Either of the following construction adhesives complying with ASTM C 557.

1. Marlite C-551 FRP Adhesive - Water- resistant, non-flammable adhesive.
2. Marlite C-915 Construction Adhesive - Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.

B. Sealant:

1. Marlite Brand - Color Match Sealant.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.

1. Verify that stud spacing does not exceed 24” (61cm) on-center.
2. Verify that substate is not subject to moisture or water vapor pressure.

B. Repair defects prior to installation.

1. Level wall surfaces to panel manufacturer’s requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures and installation sequence.

B. Cut sheets to meet supports allowing 1/8” (3 mm) clearance for every 8 foot of panel.

1. Cut panels “face-up” with a carbide-tipped table saw or cut panels “face-down” using a circular saw with a carbide-tipped blade. Leave protective film on panels when cutting.

C. Apply panels to board substrate, above base, oriented as indicated.

1. Install panels with manufacturer's recommended gap for panel field and corner joints.

a. Adhesive trowel and application method to conform to adhesive manufacturer’s recommendations.

D. Apply panel moldings to all panel edges with required clearances.

1. All moldings must provide for a minimum 1/8" (3mm) of panel expansion at joints and edges, to insure proper installation.
2. Apply sealant to all molding channels for moisture-proof installations.

3.3 CLEANING

A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.

B. Refer to manufacturer's specific cleaning recommendations.

END OF SECTION 09 7813

SECTION 09 8433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Sound-absorbing wall panels.

1.3 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include fabric facing, panel edge, core material, and mounting indicated.

B. Shop Drawings: For unit assembly and installation.

1. For custom graphic panels, provide full-color artwork elevation showing artistic effect, color, artwork, and proposed panel joint locations.

2. Include plans, elevations, sections, and mounting devices and details.
3. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
4. Include details at cutouts and penetrations for other work.

5. Include direction of fabric weave and pattern matching.

C. Samples for Initial Selection: For each type of fabric facing.

1. Include Samples of hardware and accessories involving color or finish selection.

D. Samples for Verification: For the following products:

1. Artwork: Full-size sample section of finished artwork, printed on no less than 18 by 18 inch square area of facing material, indicating color, print quality, and appearance.

2. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
3. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
4. Core Material: 12-inch- square Sample at corner.
5. Mounting Devices: Full-size Samples.
6. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations 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. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by units including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Alarms.
e. Sprinklers.
f. Access panels.

3. Show operation of hinged and sliding components covered by or adjacent to units.

B. Product Certificates: For each type of unit.

C. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

1.9 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.

1. Build mockup of typical wall area 48 inches wide by full height. Include intersection of wall and ceiling, corners, and perimeters.
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.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:

a. Acoustical performance.
b. Fabric sagging, distorting, or releasing from panel edge.
c. Warping of core.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. 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.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel SP-1: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; Soundsoak 85 Standard Acoustical Wall System, or comparable product by one of the following:

a. Acoustical Panel Systems (APS, Inc.).
b. Acoustical Solutions, Inc.
c. AVL Systems, Inc.
d. Benton Brothers Solutions, Inc.
e. Brejtfus Acoustical Interiors.
f. Conwed Designscape; an Owens Corning company.
g. Decoustics Limited; a Saint Gobain company.
h. Essi Acoustical Products.
i. Golterman & Sabo.
j. Lamvin, Inc.
k. MBI Products Company, Inc.
l. Panel Solutions, Inc.
m. Perdue Acoustics, Inc.
n. Pinta Acoustic, Inc.
o. Proudfoot Company, Inc. (The).
p. Sound Concepts Canada, Inc.
q. Sound Management Group LLC.
r. Tectum Inc.
s. Wall Technology, Inc.; an Owens Corning company.
t. Wenger Corporation.
u. Working Walls, Inc.

2. Panel Shape: Flat, custom-cut to shapes indicated, to achieve the overall assembled field shape shown in the drawings.

3. Mounting: Back mounted with manufacturer's standard impaling clips, secured to substrate.
4. Core: Glass-fiber board. Provide wood or plywood nailing strips in core where required by manufacturer for size and shape of panels.

    a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board.

5. Edge Construction: Manufacturer's standard chemically hardened core with no frame, square-edged, with integral kerf.
6. Edge Profile: Long edges kerfed and rabbeted to receive splines; square.
7. Corner Detail in Elevation: Square.
8. Reveals between Panels: None - hairline joints.
9. Facing Material: Owner-furnished material; woven acoustically-transparent fabric.
10. Acoustical Performance: Sound absorption NRC of 0.80 according to ASTM C 423 for Type A mounting according to ASTM E 795.
11. Nominal Overall Panel Thickness: 1 inch.
12. Panel Width: Custom, as indicated in the Drawings.
13. Panel Height: Custom, as indicated in the Drawings.

B. Sound-Absorbing Wall Panel SP-2: Manufacturer's standard panel construction consisting of a solid mat of through color, acoustically absorbent PET plastic fibers, with custom artwork printed on facing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kirei USA; EchoPanel 34mm thickness Acoustical Panels with custom digital printing option, or comparable product by one of the following:

    a. Acoustical Panel Systems (APS, Inc.).
    b. Acoustical Solutions, Inc.
    c. Armstrong World Industries.
    d. AVL Systems, Inc.
    e. Benton Brothers Solutions, Inc.
    f. Brejtfus Acoustical Interiors.
    g. Conwed Designscape; an Owens Corning company.
    h. Decoustics Limited; a Saint Gobain company.
    i. Essi Acoustical Products.
    j. Golterman & Sabo.
    k. Lamvin, Inc.
    l. MBI Products Company, Inc.
    m. Panel Solutions, Inc.
    n. Perdue Acoustics, Inc.
    o. Pinta Acoustic, Inc.
    p. Proudfoot Company, Inc. (The).
    q. Sound Concepts Canada, Inc.
    r. Sound Management Group LLC.
    s. Tectum Inc.
    t. Wall Technology, Inc.; an Owens Corning company.
    u. Wenger Corporation.
    v. Working Walls, Inc.

2. Panel Shape: Flat, of shapes indicated.

3. Mounting: Back mounted with manufacturer's recommended adhesive or hook-and-loop strips, secured to substrate.
4. Core: Homogenous, through-color PET plastic fiber felted mat.

    a. Core-Face Layer: PET plastic fiber felted mat, with custom-printed artwork.

5. Edge Construction: Manufacturer's standard factory-cut edge, with allowance for field-trimming to finished panel size and shape.
6. Corner Detail in Elevation: Square.
7. Reveals between Panels: None - hairline.
8. Facing Material: Factory-printed artwork, directly printed on panel face.
9. Acoustical Performance: Sound absorption NRC of 0.65, measured with no air gap behind panels.
10. Nominal Overall Panel Thickness: 24mm (15/16 inch).

11. Panel Width: Custom, as indicated.
12. Panel Height: Custom, as indicated.

2.3 MATERIALS

A. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C 612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. PET Plastic: Manufacturer's standard, through-color, non-woven, pressed into felt mat form.

B. Facing Material:

1. SP-1 Panels: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.
2. SP-2 Panels: PET felt mat surface of core, with custom-printed artwork applied directly to PET felt.

C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

1. SP-1 Panels: Impaling Clips, Manufacturer's standard.
2. SP-2 Panels: Manufacturer's recommended adhesive or hook-and-loop fasteners.

2.4 FABRICATION

A. SP-1 Panels:

1. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
2. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.
3. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
4. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

    a. Square Corners: Tailor corners.
    b. Radius and Other Nonsquare Corners: Attach facing material so there are no seams or gathering of material.

c. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.

5. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

a. Thickness.
b. Edge straightness.
c. Overall length and width.
d. Squareness from corner to corner.
e. Chords, radii, and diameters.

B. SP-2 Panels:

1. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with factory-included margins for each panel, with allowance for field-trimming to finished dimensions.
2. Edges: Factory-cut core material, unfaced.
3. Facing Material: Custom-printed, full-color artwork, directly printed on core material in the factory.
4. Dimensional Tolerances of Finished Units: Plus or minus 10mm for overall length and width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. For SP-2 Panels, field-cut every panel to exact finished panel shape and size before installation, removing the non-printed border allowance around each panel.

1. Test-fit and trim each panel to adjacent abutting panels to verify registration of printed artwork across panel joints.
2. Adjust and ensure proper trimming, size, and alignment before installation.

B. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

C. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

D. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.

B. Variation of Joint Width: Not more than 1/32-inch variation from hairline in 48 inches, noncumulative.

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09 8433

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Steel and iron.
2. Galvanized metal.

1.2 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 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. 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.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 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.

B. Samples: For each type of paint system and each color and gloss of topcoat.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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 Exterior 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: As selected by Architect from manufacturer's full range.
1. Assume forty percent of surface area will be painted with deep tones.

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. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. 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.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. 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.

3.4 CLEANING AND PROTECTION

A. 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.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:
1. Water-Based Light Industrial Coating System MPI EXT 5.1C:
a. Prime Coat: Primer, alkyd, anti-corrosive for metal, MPI #79.
1) Sherwin-Williams; Ken Bond HS.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
1) Sherwin-Williams; DTM Acrylic.

B. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.3J:
   a. Prime Coat: Primer, galvanized, water based, MPI #134.
      1) Sherwin-Williams; Pro-Cryl Universal Primer.
   b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
   c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
      1) Sherwin-Williams; DTM Acrylic.

END OF SECTION 09 9113

SECTION 09 9123 - 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 interior substrates.

1. Surface preparation, priming, and finish coats in this Section are in addition to shop priming and surface treatments specified in other Section.

B. Paint exposed surfaces, except where these Specifications indicate that the surface material is not to be painted or to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces, If a color of finish is not indicated, Architect will select from standard colors and finishes available.

1. Paint includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied finish.
2. Preparation and painting of exposed structural, mechanical and electrical items is to be performed with particular care. Prepare surfaces completely to assure adherence. Verify that material specifications are appropriate for each substrate.

C. Do not paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts and labels.

1. Pre-finished items may include but are not limited tothe following factory finished components:

a. Architectural Woodwork
b. Acoustical Wall Panels
c. Metal Toilet Partitions
d. Metal Lockers
e. Unit Kitchens
f. Finished Mechanical and Electrical Equipment
g. Lighting Fixtures

2. Concealed surfaces include walls or ceilings in the following generally inaccessible areas:

a. Foundation spaces
b. Furred Areas
c. Ceiling Plenums
d. Utility Tunnels
e. Pipe Spaces
f. Duct Shafts

3. Finished metal surfaces include but are not limited to the following:

a. Anodized Aluminum
b. Stainless Steel
c. Chromium Plate
d. Copper and Copper Alloys
e. Bronze and Brass

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. 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. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. 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. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. 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. Material List: An inclusive list of required coating materials. Indicate which material and cross reference coating, finishing system and application. Identify each material by manufacturer's catalog number and general slassification.
2. Manufacturer's information: Manufacturer's information including label analysis and instructions for handling, storing and applying each coating material.

3. Certification by the manufacturer that product supplied complies with local regulations controlling use of volatile organic compounds (VOC).

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.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples 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: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

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.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 specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..

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. Deliver materials to project site in manufacturer origial, unopened packages and containers bearing manufacturer's name and label and the following:

1. Product name or title of material
2. Product description (generic classification or binder type)
3. Manufacturer's stock number and date manufactured
4. Contents by volume for pigments and vehicle consituents
5. Thinning instructions
6. Application instructions
7. Color name and number
8. VOC content

B. 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.

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.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.9 WARRANTY

A. Manufacturer's Specialty Warranty: Manufactureragrees to replace specialty paint coatings that deteriorate within specified warranty period. Deterioration of specialty paint coatings is defined as defects developed from normal use that are not attributed to maintaining and cleaning specialty paint coatings contrary to manufacturers written instructions.

1. Warranty Period: 10 years from the 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. Behr Process Corporation.
2. Benjamin Moore & Co.
3. ICI Paints.
4. M.A.B. Paints.
5. PPG Architectural Finishes, Inc.

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 other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint 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.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

B. Primer, Alkali Resistant, Water Based: MPI #3.

C. Primer Sealer, Alkyd, Interior: MPI #45.

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based: MPI #107.

2.6 WATER-BASED PAINTS

A. Latex, Interior, High Performance Architectural, (Gloss Level 3): MPI #139.

2.7 SOLVENT-BASED PAINTS

A. Alkyd, Interior, (Gloss Level 3): MPI #51.

2.8 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 coatings 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. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. 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 Manual" applicable to substrates 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. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

G. 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.

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.

3.4 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.

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2), MPI #138.

B. CMU Substrates:

1. High-Performance Architectural Latex System:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3), MPI #139.

C. Steel Substrates:

1. Alkyd System:
a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.

D. Wood Substrates: Including wood trim .

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.

E. Gypsum Board Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3), MPI #139.

END OF SECTION 09 9123

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

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 application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

    a. Concrete masonry units (CMU).
    b. Steel.
    c. Galvanized metal.

2. Interior Substrates:

    a. Concrete masonry units (CMU).
    b. Steel.
    c. Galvanized metal.
    d. Gypsum board.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples 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: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.4 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. Coatings: 5 percent, but not less than 1 gal. 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.

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 coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.
2. Duron, Inc.
3. ICI Paints.
4. PPG Architectural Finishes, Inc.

B. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the paint category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."

B. 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.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
6. Pre-Treatment Wash Primers: 420 g/L.
7. Floor Coatings: 100 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

A. Waterborne Alkali-Resistant Primer, MPI #3.

B. Primer Sealer, Latex, Interior: MPI #50.

2.5 METAL PRIMERS

A. Rust-Inhibitive Primer, Waterborne: MPI #107.

B. Waterborne Galvanizing Primer, MPI #134.

C. Waterborne Epoxy Primer, MPI #301.

2.6 HIGH PERFORMANCE ARCHITECTURAL LATEX COATINGS

A. High Performance Architectural Interior Latex, Satin (Gloss Level 4): MPI #140.

B. High Performance Architectural Interior Latex, Semi-Gloss (Gloss Level 5): MPI #141.

C. High Performance Architectural Exterior Latex, Semi-Gloss (Gloss Level 5): MPI #311.

D. High Performance Architectural Exterior Latex, Satin (Gloss Level 4): MPI #315.

2.7 LIGHT INDUSTRIAL COATINGS

A. Waterborne Light Industrial Coating, Semi-Gloss (Gloss Level 5): MPI #151.

B. Waterborne Light Industrial Coating, Semi-Gloss (Gloss Level 5): MPI #163.

2.8 EPOXY COATINGS

A. Low VOC Epoxy, Satin (Gloss Level 4): MPI #145

2.9 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Testing agency will perform tests for compliance with product requirements.
2. 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 coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings 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. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates 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 coatings, 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 coating systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. 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 coatings.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating 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 coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. High Performance Architectural Latex over Waterborne Alkali-Resistant Primer, MPI EXT 4.2M-G4 (Gloss Level 4):

a. Primer Coat: Waterborne Alkali-Resistant Primer, MPI #3.
b. Intermediate Coat: High Performance Architectural Exterior Latex, Satin, MPI #315.
c. Topcoat: High Performance Architectural Exterior Latex, Satin, MPI #315.

B. Steel Substrates:

1. Waterborne Light Industrial Coating over Waterborne Epoxy Primer: MPI EXT 5.1M-G5 (Gloss Level 5)

a. Prime Coat: Waterborne Epoxy Primer, MPI #301.
b. Intermediate Coat: Waterborne Light Industrial Coating, Semi-Gloss, MPI #163.
c. Topcoat: Waterborne Light Industrial Coating, Semi-Gloss, MPI #163.

C. Galvanized-Metal Substrates:

1. High-Performance Architectural Exterior Latex over Waterborne Galvanizing Primer: MPI EXT 5.3M-G5 (Gloss Level 5)

a. Prime Coat: For a Premium Grade system, "MPI Manual" requires intermediate coat; delete intermediate coat for a Custom Grade system. Waterborne Galvanizing Primer, MPI #134.
b. Intermediate Coat: High-Performance Architectural Exterior Latex, MPI #311.

c. Topcoat: Retain one of two "Pigmented Polyurethane System" subparagraphs below; system in first subparagraph corresponds to MPI EXT 5.3L. High-Performance Architectural Exterior Latex, MPI #311.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. Low VOC Epoxy System, MPI INT 4.2E-G4 (Gloss Level 4):

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
b. Intermediate Coat: Low VOC Epoxy, satin, MPI #145.
c. Topcoat: Low VOC Epoxy, satin, MPI #145.

B. Steel Substrates:

1. Waterborne Light Industrial Coating, MPI INT 5.1B-G5 (Gloss Level 5):

a. Prime Coat: Rust inhibitive primer, waterborne, MPI #107.
b. Intermediate Coat: Waterborne Light Industrial Coating, semi gloss, MPI #151.
c. Topcoat: Waterborne Light Industrial Coating, semi gloss, MPI #151.

C. Galvanized-Metal Substrates:

1. High Performance Architectural Latex over Waterborne Galvanizing Primer, MPI INT 5.3M-G5 (Gloss Level 5):

a. Prime Coat: Waterborne Galvanizing Primer, MPI #134.
b. Intermediate Coat: High Performance Architectural Interior Latex, Semi-Gloss, MPI #141.
c. Topcoat:"Epoxy System" Subparagraph below corresponds to MPI INT 5.4B. High Performance Architectural Interior Latex, Semi-Gloss, MPI #141.

D. Gypsum Board Substrates:

1. High Performance Architectural Latex over Latex Primer/Sealer, MPI INT 9.2B-G4 (Gloss Level 4):

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: High Performance Architectural Interior Latex, Satin, MPI #140.
c. Topcoat: High Performance Architectural Interior Latex, Satin, MPI #140.

END OF SECTION 09 9600

SECTION 10 1419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.

a. Cast dimensional characters.

1.2 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.3 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: [Full-size Sample] [Half-size Sample] <Insert size> of each type of dimensional character.
2. Exposed Accessories: Half-size Sample of each accessory type.
3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.

E. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

F. Delegated Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.

b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings.

C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 DIMENSIONAL CHARACTERS

A. Cast Characters : Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.R.K. Ramos.
b. ACE Sign Systems, Inc.
c. ASI Sign Systems, Inc.
d. Cosco.
e. Gemini Incorporated.
f. Matthews International Corporation; Bronze Division.
g. Metal Arts.
h. Metallic Arts.
i. Southwell Company (The).

2. Character Material: Cast aluminum.
3. Character Height: As indicated on Drawings.
4. Thickness: Manufacturer's standard for size of character.
5. Finishes:

a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.

6. Mounting: Projecting studs.
7. Typeface: Timesa New Roman.

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

a. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.6 GENERAL FINISH REQUIREMENTS

A. 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.

B. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 1419

SECTION 10 1423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Room-identification signs.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: Full-size Sample.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule. Final room names and text shall be determined during the shop drawing process. Contractor shall submit proof for each signs text prior to fabrication.

1.6 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for signs.

2.2 SIGNS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:

1. ASI Sign Systems, Inc.
2. Mohawk Sign Systems.

B. Room-Identification Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: Mohawk Sign System MP 200 A Format.
2. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.

a. Composite-Sheet Thickness: 0.125 inch.
b. Color(s): As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

a. Architect shall choose from manufacturer's custom and standard shapes.

1) Approximate size of room signs shall be 6 by 6 inch
2) Approximate size of toilet room signs shall be 8 by 8 inch. Toilet room signs shall include graphic indicators chosen by architect from manufacturer's standard symbols.

b. Edge Condition: Beveled.

4. Mounting: Manufacturer's standard method for substrates indicated with adhesive.
5. Text and Typeface: Accessible raised characters and Braille. Font shall be Gill Sans, 3/4 inches high. Room names may be changed through the shop drawing review process. Provide two signs per interior door.
6. Location and Quantity: Signage shall be provided at a minimum of everydoorway throughout the building. Final text for signs shall be determined during the shop drawing phase of the project.

2.3 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are 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.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls according to accessibility standard.

C. Mounting Methods:

1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 1423

SECTION 10 1426 - BUILDING MOUNTED SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Internally illuminated building mounted cabinet signs.

1.3 DEFINITIONS

A. Internally Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 COORDINATION

A. Furnish templates and tolerance information for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signage.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

D. Samples for Verification: For each type of sign assembly, showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Not less than 12 inches square.
2. Exposed Accessories: Half-size Sample of each accessory type.

E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of [anchorage devices] [and] [electrical service] embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Deterioration of finishes beyond normal weathering.
    b. Deterioration of embedded graphic image.
    c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design sign structure and anchorage of post-and-panel sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings.
2. Concentrated Horizontal Load: As indicated on Drawings.
3. Other Design Load: As indicated on Drawings.
4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BUILDING MOUNTED PANEL SIGNS

A. Hollow-Box Signs: Units constructed in a hollow-box configuration; with smooth, uniform surfaces and support assembly; with opaque metal sides, and frameless, translucent plastic illuminated faces; of types and designs indicateds in the Drawings. Message and characters shall have uniform faces, sharp corners, and precisely formed lines and profiles.

1. Manufacturers: Subject to compliance with requirements, available manufacturers providing products include, but are not limited to, the following:

    a. iSIGN, Inc.

b. ACE Sign Systems, Inc.
c. A.R.K. Ramos Signage Systems
d. Metal Arts; Division of L & H Mfg. Co.

2. Hollow-Box Sign Frame: Entire perimeter framed with formed-aluminum sheet or extruded-aluminum, hollow-box-type frame with vertical edges attached to supports with aluminum fittings. Close top and bottom edges of panels with manufacturer's standard welded seams or extrusions.

   a. Hollow-Box Depth: 3 inches.
   b. Edge profile: Custom-shaped as indicated in the Drawings.
   c. Finish and Color: Painted finish, as selected by Architect from manufacturer's full range of color options.

3. Sign-Frame Mounting: As indicated on Drawings.

4. Sign-Panel-Face Finish and Applied Graphics:

   a. Integral Aluminum Finish: Aluminum with color finish. Architect shall select color from manufacturer's full color range.
   b. Inset, Cutout Acrylic Letters: Sign face routed to receive push-through acrylic letters slightly projecting from the sign panel.

      1) Color: as selected by Architect from manufacturer's full range.

      2) See drawings for text, size, and typeface.

2.3 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in locations concealed from view after final assembly.
2. Mill joints to tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
4. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.

B. Sign Message Panels: Construct sign-panel surfaces to be smooth and to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
2. Increase panel thickness or reinforce with concealed stiffeners or backing materials as needed to produce surfaces without distortion, buckles, warp, or other surface deformations.
3. Continuously weld joints and seams unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are 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.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs.

C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.

D. Verify that electrical service is correctly sized and located to accommodate signs.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using installation methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign components are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 1426

SECTION 10 2113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes solid-plastic toilet compartments configured as toilet enclosures entrance screens urinal screens.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.

C. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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 A117.1for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Comtec Industries; Standard HDPE Zero-Sightlineor comparable product by one of the following:

1. Ampco, Inc.
2. Bradley Corporation; Mills Partitions.
3. Hadrian Manufacturing Inc.
4. Marlite.
5. Scranton Products.

B. Toilet-Enclosure Style: Overhead braced.

C. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.

D. Pilaster Shoes: Manufacturer's standard design; stainless steel.

E. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
2. Hinges: Manufacturer's standard continuous, cam type that swings to a partially-open position.
3. Latch and Keeper: Manufacturer's standard surface-mounted extruded clear anodized aluminum unit designed for emergency access from exterior, and with a combination rubber-faced door strike and keeper.
4. Coat Hook: Manufacturer's standard chrome-plated cast metal combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors. Provide at both sides of doors at compartments 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 the 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 FABRICATION

A. Fabrication, General: 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: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments 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: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Full-Height (Continuous) Brackets: Secure panels 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.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to 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 10 2113.19

SECTION 10 2600 - 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.

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.

B. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

1. Include Samples of accent strips and accessories to verify color selection.

1.4 INFORMATIONAL SUBMITTALS

A. 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- 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 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 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.

a. Store corner-guard covers in a vertical position.
b. Store covers in a horizontal position.

1.8 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 of each type 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.

2.3 CORNER GUARDS

A. Surface-Mounted, Plastic-Cover Corner Guards CG-1: Manufacturer's standard assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design: Subject to compliance with requirements, provide ProTek Systems, CG-20R Corner Guard, or comparable product by one of the following:

a. American Floor Products Company, Inc.
b. Construction Specialties, Inc.
c. InPro Corporation (IPC).
d. JL Industries, Inc.; a division of the Activar Construction Products Group.
e. Korogard Wall Protection Systems; a division of RJF International Corporation.
f. Musson Rubber Co.
g. Nystrom, Inc.
h. Pawling Corporation.
i. Tepromark International, Inc.
j. WallGuard.com.
k. wallProtex.

2. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness; as follows:

a. Profile: Nominal 2-inch- long leg and 1/4-inch corner radius.

b. Height: 4 feet.
c. Color and Texture: As selected by Architect from manufacturer's full range.

3. Continuous Retainer: Minimum 0.060-inch- thick, one-piece, extruded aluminum.
4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.4 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. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. 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.

2.6 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 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. Adjust caps as required to ensure tight seams.

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 10 2600

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Private-use bathroom accessories.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Products: Provide products as specified in the Drawings by manufacturer and model number, or comparable products by other manufacturers.

2.3 PRIVATE-USE BATHROOM ACCESSORIES

A. Source Limitations: Obtain private-use bathroom accessories from single source from single manufacturer.

B. Products: Provide products as specified in the Drawings by manufacturer and model number, or comparable products by other manufacturers.

2.4 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 2800

SECTION 10 4413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Sections:

1. Section 10 4416 "Fire Extinguishers."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1.6 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 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), manufacturers standard thickness, with Finish 1 (smooth or polished).

2.2 FIRE PROTECTION CABINET FEC

A. Cabinet Type: Suitable for fire extinguisher .

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. Larsen's Manufacturing Company; Architectural Series Fire Extinguisher Cabinets.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Steel sheet.

D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Rolled-Edge Trim

    a. FEC: 1 1/2 inch backbend depth

E. Cabinet Trim Material: Stainless-steel sheet .

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame .

H. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color: 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.

1. Provide projecting door pull and friction latch .
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

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. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

    a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet door opposite side of handle and glazing.
        2) Application Process: Engraved.
        3) Lettering Color: White.
        4) Orientation: Vertical with letters read from bottom up.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:

    a. Exterior of cabinet except for those surfaces indicated to receive another finish.
    b. Interior of cabinet.

2. Steel: Baked enamel or powder coat.
3. Stainless Steel: No. 4.

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.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. 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.

2.5 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel..

B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicatedor, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 4413

SECTION 10 4416 - FIRE EXTINGUISHERS

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 portable, fire extinguishers and mounting brackets for fire extinguishers.

1.3 Related Sections:

1. Section 10 4413 "Fire Extinguisher Cabinets."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 QUALITY ASSURANCE

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.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.8 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.9 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. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
c. Larsen's Manufacturing Company.

2. Handles and Levers: Manufacturer's standard.
3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container FEX-1: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

1. Locations: Throughout Barrack portion of building.

C. Multipurpose Dry-Chemical Type in Steel Container FEX-2: UL-rated 4-A:40-BC, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

1. Locations: All garage and vehicle service / support areas.

D. Purple-K Dry-Chemical Type in Brass Container FEX-3: UL-rated 80-B:C, 10-lb nominal capacity, with potassium bicarbonate-based dry chemical in chrome-plated brass container.

1. Location: Fuel Dispensing Area (outdoor area).

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Fire extinguishers shall be placed in all Fire Extiguisher Cabinets indicated within drawings as well as in all mechanical rooms, electrical rooms, and elevator machine rooms, whether specifically indicated in the Drawings or not.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 4416

SECTION 10 5113 - WELDED METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Personal Storage Lockers.

1.3 REFERENCES

A. American National Standards Institute (ANSI) Standards:

1. Applicable standards for fasteners used for assembly.

B. American Society for Testing and Materials (ASTM) Standards:

1. Applicable standards for steel sheet materials used for fabrication

2. Applicable standards for the testing of electrostatically applied Powder Coat Paint

C. American Institute Of Steel Construction (AISC) Standards:

1. Applicable standards for steel materials used for fabrication.

1.4 DESCRIPTION

A. General: Welded Metal Lockers only with end-user reconfigurable interior. Specialized lances to provide the flexibility of on-site, end-user reconfiguration/addition of internal components anytime, anywhere, now or in the future.

B. Finishes:

1. Fabricated Metal Components and Assemblies: All components to be painted with an electro-statically applied Powder Coat paint that can meet or exceed test requirements set out by ASTM standard D3451-06 Standard Guide for Testing Coating Powders and Powder Coatings.

C. Sizes:

1. Provide single-tier units where indicated, with a total size of 72 inches high x 18 inches wide x 18 inches deep.

2. Provide two-tier units where indicated, comprised of two equal tiers per unit, with a total size of 72 inches high x 18 inches wide x 18 inches deep.

1.5 PERFORMANCE REQUIREMENTS

A. Design Requirements:

1. Limit overall width not to exceed specified nominal width; locker width designed for zero growth.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of welded metal locker required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details, including descriptions of procedures and diagrams. Show complete locker installation layout, including quantities, locations and types of accessory units required. Include notations and descriptions of all installation items and components.

C. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts, consisting of actual product pieces, showing full range of colors and textures available.

D. Warranty: Submit draft copy of proposed warranty for review

E. Maintenance Data: Provide written documentation of the manufacturer's statement, claiming the maintenance free nature of the product.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001:2008 certified for the design, production, installation and service of welded metal lockers. Furnish certification attesting ISO 9001:2008 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is the manufacturer's authorized representative for the specified products for installing welded metal lockers.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer's instructions and recommendations for delivery, storage and handling requirements.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify quantities of welded metal locker units before fabrication. Indicate verified measurements on shop drawings. Coordinate fabrication and delivery to ensure no delay in progress of the work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating welded metal lockers units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.10 SEQUENCING AND SCHEDULING

A. Sequence welded metal lockers [with other work] to minimize possibility of damage and soiling, during remainder of construction period.

B. Schedule installation of specified welded metal lockers after finishing operations, including painting, have been completed.

C. Provide components, which must be built in at a time, which causes no delays in the general progress of the work.

1.11 Warranty

A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units, which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Condition's provisions of the Contract Documents.

B. Limited Lifetime Warranty: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the locker frames manufactured by it will be free from defects in materials and workmanship for the lifetime of the locker.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Provide FreeStyle Personal Storage Lockers in single-tier and two-tier configurations; based upon welded metal lockers manufactured by Spacesaver Corporation, 1450 Janesville Avenue, Fort Atkinson, Wisconsin 53538-2798, and distributed by Storagelogic of Maryland, Inc. 410-472-0824.

1. Substitutions: Comparable products by Republic will be considered, subject to compliance with requirements.

2.2 BASIC MATERIALS

A. General: Provide materials and quality of workmanship, which meets or exceeds established industry standards for products specified. Use furniture grade sheet metal, fasteners for component fabrication unless indicated otherwise. Material thicknesses/gauges are manufacturer's option unless indicated otherwise.

2.3 LOCKER TYPES

A. Freestyle Personal Storage Lockers by Spacesaver Corporation, or comparable product by other manufacturer indicated. Provide single-tier and 2-tier lockers equipped with accessories indicated.

2.4 MANUFACTURED COMPONENTS

A. Welded Frame:

1. The welded frame must consist of top, bottom, back, and sides constructed of a minimum of 18-gauge All frame components shall be joined using resistance welding. Riveting of structural members will not be permitted.
2. Horizontal front flanges will be a minimum of 2 inches. Vertical front flanges will be a minimum of 1 inch. Horizontal and vertical flanges will overlap and be secured with a minimum two (2) resistance welds per corner.
3. Corner gussets shall be MIG and spot welded in each of the four front corners of the locker for increased stiffness and rigidity.
4. Provide side panel lances evenly spaced on 3 inch. Lances to provide the flexibility of on-site, end-user reconfiguration/addition of internal components anytime, anywhere, now or in the future.
5. Lockers shall be prepared with mounting holes for attaching necessary trim components

6. Locker shall be prepared with mounting holes for ganging lockers back-to-back or side-by-side
7. Base of lockers shall include four 4 3/8-16 UNC threaded weld-nuts and corresponding leveling feet.
8. End Panels: End Panels with no exposed fasteners shall be provided on the end of each locker run; thus providing a clean and aesthetically pleasing appearance.
9. All locker sizes and types to be in locations.

B. Personal Storage Lockers E8:

1. Single-tier configuration: 12 inches W x 18 inches D x 72 inches H.

C. Personal Storage Lockers E14:

1. Two-tier configuration: 18 inches W x 18 inches D x 72 inches total H, comprised of (2) equal-height compartments.

D. Ventilation:

1. Provide ventilation through door panels.

E. Doors:

1. Shall be single-piece, welded construction.

2. Shall be formed from two (2) pieces of minimum 18-gauge cold rolled steel box formed and welded together using modern GMAW techniques. Single-piece door with inner and outer door panels shall have a combined steel thickness of no less than 0.096 inches or thick. Welded door design with inner panel optimizes structural integrity of locker door system over and above any single frame door design.
3. Exterior door panel shall be constructed with formed flanges and return flanges to add stiffness.
4. Internal door panel shall be constructed with formed flanges for added stiffness.
5. Inner door panels shall be full height.
6. Inner door panel to have peg board style hole pattern, allowing the attachment of Document Holder and any standard peg board accessory.
7. External door panel shall have louvers to provide adequate air circulation throughout locker system.
8. Louvered air vents shall be approximately 3 inches in width and 0.75 inches or in height and spaced on 1 inch centers.
9. All doors shall have neoprene silencers on each door for noise reduction
10. Door torsional deflection shall not exceed 0.1875 inch with a 20lb point load. (Test data to be provided by manufacturer upon request)
11. Hinge:

F. Hinges:

1. Provide 16-gauge, full length hinges.

2. Hinges to be welded to door frame with spot welds not to exceed 6 inch separation.
3. Door assembly to be riveted to door frame on factory pre-established holed pattern.

G. Locking Mechanism: Provide padlock hasps.

H. Interior/Accessory components for all types of lockers:

1. All interior components must be constructed of minimum 18-gauge steel except where otherwise indicated.
2. All interior components shall be available both at time of order, and available as post-installed upgrades in the future.

I. Shelf with integral hanger bracket

1. Size specified by locker width and depth.
2. Provide one (1) shelf per tier, with Integral Hanger Bracket
3. Hanger bracket designed with perforations on approximately 3 inch centers to insure clothing separation for optimum ventilation.
4. Performance: Uniform load rating 300 lbs.
5. Shelf rear return flange stops minimum 0.50 inch short of locker back panel on order to allow air circulation throughout entire locker assembly.
6. Hooks

a. Provide 3-Hook Bracket Hanger Assembly in each locker tier.

J. Locker Tag Numbers

1. Provide locker numbers on each locker, per customer numbering requirements.

K. ACCESSORIES:

1. ZeeBase System: Provide manufacturer's standard.
2. Trim and Fillers: Provide manufacturer's standard.
3. Continuous Sloped Top where indicated. Provide manufacturers standard.

2.5 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the work.

2.6 FINISHES

A. Colors: Selected from manufacturer's standard available colors.

B. Paint Finish: Textured - Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Society for Testing and Materials (ASTM) Standards:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Lockers scheduled to receive accessories with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of specified accessory items.

B. Proceed with accessory installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Follow manufacturer's written instructions for installation of each type of accessory item specified.

3.3 FIELD QUALITY CONTROL

A. Verify accessory unit alignment and plumb after installation. Correct if required, following manufacturer's instructions.

B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust all accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris, resulting from installation, upon completion of work and leave areas of installation in neat, clean condition.

END OF SECTION

SECTION 10 7516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ground-set flagpoles made from aluminum.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Delegated-Design Submittal: For flagpoles.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design flagpole assemblies.

B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 120 MPH.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.

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: (Basis of Design Manufacturer is Eder Flag Manufacturing Company, Inc.

    a. Acme/Lingo Flagpoles LLC.
    b. American Flagpole; a Kearney-National Inc. company.
    c. Baartol Company.
    d. Concord Industries, Inc.
    e. Eder Flag Manufacturing Company, Inc.
    f. Ewing Flagpoles.
    g. Morgan-Francis Flagpoles and Accessories.
    h. Pole-Tech Company Inc.
    i. U.S. Flag & Flagpole Supply, LP.

B. Exposed Height: As indicated in the Drawings.

C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch wall thickness with 3/16-inch steel bottom plate and support plate; 3/4-inch- diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball.

1. 0.063-inch spun aluminum with gold anodic finish.
2. Diameter: 6 inches.
3. Basis of Design: Model SB106 as manufactured by Eder Flag Manufacturing Company

B. Formed Finial Eagle:

1. Aluminum with gold anodic finish.
2. Basis of Design: Model EII as manufactured by Eder Flag Manufacturing Company.

C. Formed Finial Botony Cross:

1. Aluminum with gold anodic finish.
2. Size: 12 x 12 inches.

D. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweght and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Stainless-steel swivel snap hooks. Furnish two per halyard.

2.5 MISCELLANEOUS MATERIALS

A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

B. Sand: ASTM C 33/C 33M, fine aggregate.

C. Elastomeric Joint Sealant: Single-component nonsag urethane joint sealant complying with requirements in Section 07 9200 "Joint Sealants."

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

D. Place concrete, as specified in Section 03 3000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 10 7516

SECTION 12 2413 - 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 06 1000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 07 9200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

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.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. 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.

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.

1.10 WARRANTY

A. Hardware Warranty: Manufacturer agrees to replace operating hardware that fails in operation or is defective in materials or workmanship during the Warranty Period.

1. Warranty Period: Ten (10) years from the date of Substantial Completion.

B. Shadecloth Warranty: Manufacturer agrees to replace standard shadecloth that fails in operation or is defective in materials or workmanship during the Warranty Period.

1. Warranty Period: Twenty-five (25) years from the date of Substantial Completion.

C. Installation Warranty: Manufacturer agrees to repair or replace defective installation materials and workmanship during the Warranty Period, not including cost for scaffolding, lifts, or other means of reaching inaccessible areas, if necessary to repair installation.

1. Warranty Period: One (1) year from Substantial Completion.

PART 2 - PROUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS E6 AND E7

A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade; Mecho/5 or comparable product by one of the following:

1. Draper Inc.
2. Hunter Douglas Contract.
3. Insolroll Window Shading Systems.
4. Lutron Electronics Co., Inc.
5. OEM Shades Inc.
6. Qmotion Shades.
7. Silent Gliss.
8. SM Automatic, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal .

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 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:

a. For stand-alone individual shades, right side of interior face of shade.
b. For pairs of shades installed within one framed opening, left side of interior face of left-hand shade, and right side interior face of right-hand shade, for mirror image orientation of drive ends.

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. Shadebands:

1. Shadeband Material:

a. Roller Shade E6: Light-filtering fabric.
b. Blackout Roller Shade E7: Light-blocking fabric.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

F. Installation Accessories:

1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 3 inches.

2. Endcap Covers: To cover exposed endcaps.

3. Side Channels:

a. Blackout Roller Shade E7: Provide side channels with light seals 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:

a. Blackout Roller Shade E7: Provide bottom (sill) Channel or Angle light seals 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.

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.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. TypePVC-coated polyester.
3. Weave: Basketweave.
4. Thickness: Not less than 0.034 inch.
5. Weight: 19.17 oz/sq. yd..
6. Orientation on Shadeband: Up the bolt.
7. Openness Factor: 5 percent.
8. Color: As selected by Architect from manufacturer's full range.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: Opaque vinyl-coated fiberglass.
3. Thickness: Not less than 0.013 inch.
4. Weight: 12.50 oz./sq. yd..
5. Orientation on Shadeband: Up the bolt.
6. Features: Washable.
7. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER SHADE FABRICATION

A. 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.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

C. 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. 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, 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 to interior face of glass.

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.

END OF SECTION 12 2413

SECTION 12 3661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Initial Selection: For each type of material exposed to view.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings E. I. du Pont de Nemours Company; Corian Solid Surface or comparable product by one of the following:

    a. Avonite Surfaces.
    b. Formica Corporation.
    c. LG Chemical, Ltd.
    d. Samsung Chemical USA, Inc.
    e. Transolid Div of Trumbull Industries.
    f. Wilsonart International Holdings, Inc.

2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
4. Colors and Patterns:

    a. For Basis-of-Design, of the manufacturer's seven (7) price categories, Architect's choice from categories 1 through 5.
    b. For other manufacturers, Architect's choice from manufacturer's full range.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Countertops: 3/4-inch- thick, solid surface material.

C. Backsplashes: 1/2-inch- thick, solid surface material.

D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.
2. Install integral sink bowls in countertops in the shop.

E. Joints: Fabricate countertops without joints.

1. If lengths or configurations of countertops make seamless construction impracticable, then fabricate in largest sections possible with field joints, and clearly indicate proposed joint locations in shop drawings

F. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

I. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3661.16

SECTION 12 3661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

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. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Initial Selection: For each type of material exposed to view.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide E. I. du Pont de Nemours and Company; Corian Quartz or comparable product by one of the following:

a. Cambria.
b. LG Chemical, Ltd.
c. Meganite Inc.
d. Samsung Chemical USA, Inc.

2. Colors and Patterns: As selected by Architect from manufacturer's full range.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Countertops: 3/4-inch- thick, quartz agglomerate with front edge built up with same material.

C. Backsplashes: 1/2-inch- thick, quartz agglomerate.

D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

E. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.

1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
2. Joint Type: Bonded, 1/32 inch or less in width.
3. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

F. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

F. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3661.19

PROJECT MANUAL
Volume 02: Divisions 21 through 32

Cumru Fire Department

Project No: 18-036

1775 Welsh Road
Mohnton, Pennsylvania 19540

PREPARED FOR:

CUMRU FIRE DEPARTMENT
1775 Welsh Road
Mohnton, Pennsylvania 19540

BID SET
November 30, 2023

SECTION 21 0110 - FIRE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general provisions of Contract, as well as Division-22 and Division-26 sections shall apply to this Section.

1.2 SUMMARY

A. This Section specifies automatic sprinkler systems for buildings and structures. Materials and equipment specified in this Section include:

1. Pipe, fittings, valves, and specialties;
2. Sprinklers, and accessories.
3. Fire and jockey pumps.

B. Products furnished but not installed include sprinkler head cabinet with spare sprinkler heads. Furnish to the Owner's maintenance personnel.

1.3 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Other definitions for fire protection systems are listed in the most current edition of NFPA Standards 13 and 20.

C. Working Plans as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in the most current edition of NFPA 13 for obtaining approval of the authority having jurisdiction.

1.4 SYSTEM DESCRIPTION

A. Fire Flow Test Data:

1. Flow Hydrant:

a. Location: _____

b. Pitot Pressure: _____PSI

c. Outlet Diameter: _____Inches

d. Flow: _____GPM

e. Nozzle Coefficient: _____

f. Corrected Flow: _____GPM

g. Main Size: _____Inches

2. Residual Hydrant:

a. Location: _____

b. Static Pressure: _____PSI

c. Residual Pressure: _____PSI

d. Loss: _____

e. Loss at 20 PSI (140 kPa):_____

f. Main Size: _____Inches

3. Date of Flow Test:

4. The above information is for informational purposes only. The Contractor shall provide an independent flow test to confirm flow and pressure availability.

1.5 SUBMITTALS

A. Product Data: Include each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection, fire and jockey pumps and fire department valve cabinet specified.

B. Shop Drawings: Submit drawings which have been prepared in accordance with the most current editions of NFPA, UL, FM, as well as the owner's insurance carrier requirements. Shop drawings shall include hydraulic calculations where applicable, and which have been approved by the authority having jurisdiction.

1. Sprinkler shop drawings shall be integrated into the Contractor's installation/coordination drawings.

2. Shop drawings shall include a written statement indicating compliance with all applicable requirements of NFPA, UL, FM, and the Owner's insurance carrier.

C. Coordination Drawings: Detail fire protection piping systems in accordance with Division-22 Section "Basic Plumbing Requirements." Fire protection piping shall be coordinated with work of all other trades.

D. Maintenance Data: For each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection, fire and jockey pump, and fire department valve cabinet specified, include in operating and maintenance manual.

E. Manufacturer Seismic Qualification Certification: Submit certification that the fire protection equipment, piping and accessories will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

   b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Structural Performance: Pipe hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

4. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

5. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the

seismic event."

F. Quality Control Submittals:

1. Welders' qualification certificates. Submit for each qualified welder the following documentation according to AWS B2.1. Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), Welder Qualification Record (WQR), verifying the AWS qualification within the previous six (6) months, or certified work history showing no break in work.

2. Test Reports and Certificates: Include "Contractor's Material & Test Certificate for Aboveground Piping" and "Contractor's Material & Test Certificate for Underground Piping" as described in the most current edition of NFPA 13.

3. Internal Inspection of Piping; where sprinkler piping is welded, an obstruction investigation will be conducted and report submitted.

G. Computer (CADD) files of drawings will not be made available to the Contractor for any purposes.

1.6 MATERIAL, EQUIPMENT AND SUBSTITUTION REQUIREMENTS

A. Use products of one manufacturer where two or more items of same kind of equipment are required.

B. Materials and equipment shall have a record of two (2) years successful field use.

C. Where a specific manufacturer is listed on the drawings, that manufacturer shall be considered the basis of design for that particular item of equipment. Only the basis of design manufacturer has been verified to meet the project requirements (i.e. dimensions, weights, service clearances, electrical requirements, etc.).

D. Where the drawings and/or specifications indicate more than one manufacturer for a particular item of equipment, only those listed may submit products and services to be included in the work; manufacturers other than those listed will not be acceptable. Should the contractor choose to use one of the specified manufacturers other than the basis of design, it shall be the responsibility of the contractor to verify that the equipment meets all project requirements including, but not limited to, verification of all dimensions, weights, service clearances, electrical requirements, etc. All changes incurred shall be the responsibility of the contractor and shall be provided at no additional cost to the owner.

E. Substitutions must be submitted for consideration seven (7) days prior to the original bid date. Consideration of substitutions shall be at the sole discretion of the Engineer. Substitution submittals shall include all information required in the "Submittals" paragraph of this specification section, as well as all other requirements indicated through the Division-23 specifications. Substitutions will not mitigate, in any way, the Contractor's responsibility in complying with the coordination, contract requirements or design intent. Any additional electrical, structural or special requirements, etc. shall be the responsibility of the Contractor. Also, any additional cost incurred as a result of substitution shall be the responsibility of the Contractor.

F. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

G. Where items of equipment are indicated as Base Bid on the bid form include in the Bid price the cost of providing the equipment upon which the specification is based. In addition, submit with bid for Owner's consideration the amount to be added or deducted from the base bid for other listed manufacturers' equipment. Owner will advise Contractor within forty-five (45) days after award of contract of his selection.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by a qualified installer having a minimum of five (5) years' experience with work similar in size and scope to this project.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS B2.1", Specifications for Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3."

C. Regulatory Requirements: Comply with the requirements of the most current edition of the following codes:

1. NFPA 13 - Standard for the Installation of Sprinkler Systems.

2. NFPA 20 - Standard for the Installation of Centrifugal Fire Pumps.

3. UL and FM Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled,

and Factory Mutual approved for the application anticipated.

4. In addition to all regulatory requirements, the complete fire protection system shall meet the requirements of the Owner's insurance carrier.

D. Miscellaneous Materials:

1. Sprinkler Wrenches: Furnish to Owner, two (2) wrenches for each type of sprinkler head installed as provided by the sprinkler manufacturer.

2. Sprinkler Heads and Cabinets: Furnish six extra sprinkler heads of each style included in the project. Furnish each style with its own sprinkler head cabinet and special wrenches as specified in this Section.

E. Structural Certification:

1. The Sprinkler Contractor shall provide certification from a Pennsylvania Registered Engineer that the building structure is capable of supporting all proposed sprinkler system piping and components. The certification letter must be signed and sealed prior to the submission of shop drawings.

2. Refer to seismic requirements in Seismic and Wind Controls.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire protection system products which may be incorporated in the work include the following:

1. Gate Valves:

a. Fairbanks

b. Jenkins

c. Kennedy Valve, Div of ITT Grinnell Valve Co., Inc.

d. Stockham

2. Swing Check Valves:
    a. Fairbanks
    b. Jenkins
    c. Kennedy Valve, Div of ITT Grinnell Valve Co., Inc.
    d. Stockham
    e. Victaulic
    f. Reliable Automatic Sprinkler Co., Inc.
3. Grooved Mechanical Couplings:
    a. Stockham
    b. Victaulic
4. Water Flow Indicators:
    a. Reliable Automatic Sprinkler Co., Inc.
    b. Viking Corp.
5. Electric Alarm Gong:
    a. Reliable Automatic Sprinkler Co., Inc.
    b. Victaulic
6. Detector Check Valves:
    a. Ames Company, Inc.
    b. Kennedy Valve, Div of ITT Grinnell Valve Co., Inc.
7. Siamese Connection:
    a. Guardian Fire Equipment, Inc.
    b. Elkhart Brass
8. Sprinkler Heads:
    a. Johnson Controls International

b. Reliable Automatic Sprinkler Co., Inc.

c. Viking Corp.

d. Victaulic

9. Fire and Jockey Pumps:

a. Peerless

b. ITT A-C

c. Aurora

2.2 PIPING MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where more than one type of materials or products are indicated, selection is Installer's option. All products in a grooved system shall be of the same manufacturer.

2.3 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-22 section "Identification for Plumbing Piping and Equipment".

2.4 BASIC PIPES AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings complying with Division-22 section "Pipe, Tube and Fittings for Plumbing Systems", in accordance with the following listing:

1. Pipe Size 2" (50 mm) and Smaller: Black steel pipe; Schedule 40; cast-iron threaded.

2. Pipe Size 2" (50 mm) and Smaller: Black steel pipe; Schedule 10; roll-grooved fittings.

3. Pipe Size 2-1/2" (65 mm) and Larger: Black steel pipe; Schedule 10; welded or grooved-end fittings, ductile iron.

4. “Weld-o-let” or “Thread-o-let” fittings shall be used for branch/runouts to sprinkler heads.

5. "U-bolt" clamps, Gruvlok clamps or socket type tees shall not be used and will not be acceptable.

2.5 BASIC VALVES

A. Gate Valves - 2 Inch (50 mm) and Smaller: Body and bonnet of cast bronze, 175 pound (1200 kPa) cold water working pressure - non-shock, threaded ends, solid wedge. outside screw and Yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.

B. Gate Valves - 2-1/2 Inch (65 mm) and Larger: Iron body; bronze mounted, 175 pound (1200 kPa) cold water working pressure - non-shock. Valves shall have solid taper wedge; outside screw and Yoke, rising stem; flanged bonnet with body and bonnet conforming to ASTM A 126 Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open.

C. Swing Check Valves: MSS SP-71; Class 175, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

D. Automatic Air Release Valves for Fire Protection System: FM approved for 175 psig (1210 kPa) working pressure, brass construction automatic float type air vent used to reduce the amount of air trapped in a pressurized wet pipe fire system. Air vent shall be 1/2" NPT inlet with 40 mesh type strainer and 1/2" male NPT outlet to drain. Provide 1/2" ball valve and nipple. Air vent shall be Potter Model PAV. Drain shall be extended to nearest storm water piping with backwater valve.

E. Detector Check Valves: Galvanized cast iron body, with a bolted cover with air bleed device for access to internal parts; 175 psig (1200 kPa) working pressure. One piece bronze disc with bronze bushings, pivot and replaceable seat. Provide threaded bypass taps in the inlet and outlet for bypass meter connection. Valve shall be set to allow minimal water flow through the bypass meter; when major water flow is required, the water pressure will fully open the clapper.

2.6 AUTOMATIC SPRINKLERS

A. Sprinkler Heads: Fusible link or glass bulb type, and style as indicated or required by the application. All heads shall be UL listed/FM approved. For

each application, all heads shall be of the same manufacturer. Unless otherwise indicated, provide heads with nominal 1/2 inch (13 mm) discharge orifice, for "Ordinary" temperature range.

B. Sprinkler Head Finishes: Provide heads with the following finishes:

1. Upright or Pendent Styles: Standard bronze finish for heads in unfinished spaces and not exposed to view. Heads shall be wax-coated where installed exposed to acids, chemicals, or other corrosive fumes.

2. Recessed Ceiling and Sidewall Styles: Bright chrome, with painted white escutcheon plate.

3. Concealed Style: Rough brass and painted white cover, screwed-on adjustment plate.

4. Intermediate Level Style: Bright chrome.

5. Extended Coverage: bright chrome.

C. Provide quick response sprinkler heads throughout the building.

D. Provide high temperature sprinkler heads in equipment spaces where pressure and temperature relief valve(s) are to be installed.

E. For fire pump applications, all sprinkler heads shall be 250 psi (1710 kPa).

F. Sprinkler Head Cabinet and Wrench: Finished steel cabinet, suitable for wall mounting, with hinged cover and space for six (6) spare sprinkler heads plus sprinkler head wrench. Provide a separate cabinet for each style sprinkler head on the project.

2.7 SIAMESE CONNECTIONS

A. Wall Type Siamese Connections: Polished cast brass, flush wall type, with wall escutcheon and two-way connections. Connection sizes shall be 4 inch (100 mm) outlet and two 2-1/2 inch (65 mm) female inlets, having NH standard threads, for the connection size indicated, as specified in NFPA. Each inlet shall have a clapper valve, and plug and chain. Unit shall have wall escutcheon of cast brass, finish to match connections, with words "STANDPIPE" or "AUTO SPKR", or "AUTO SPKR & STANDPIPE" in raised letters.

2.8 ALARM DEVICES

A. General: Types and sizes shall mate and match piping and equipment connections.

B. Water Flow Indicators: Vane type waterflow detector, rated to 250 psig (1724 kPa); designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 2.5 ampere 24 Volts DC; complete with factory-set, field-adjustable retard element to prevent false signals, and tamper-proof cover which sends a signal when cover is removed.

C. Electric Alarm Gongs: 10 inch (250 mm) diameter cast aluminum gong, with factory-finish in red enamel; bell shall be weatherproof and listed for outdoor use by Underwriters Laboratories and Factory Mutual. Power supply shall be compatible with fire alarm control panel. Alarm bell shall be motor driven with under dome striker.

D. Supervisory Switches: SPST, normally closed contacts, designed to signal valve in other than full open position.

2.9 FIRE PUMP

A. Fire Pump - Electric Motor Driven:

1. Furnish and install where shown on the drawings, Fire Pump System complete with pump, electric driver, controller and all related accessories. The pump unit shall be UL listed -- FM approved. The pumping unit shall meet all requirements of NFPA Standard 20. The fire pump shall be of capacity as indicated on the drawings. The pump shall also deliver not less than 150% of rated capacity at a pressure not less than 65% rated pressure. The shut off pressure shall not exceed 120% of rated pressure. The pump shall operate at a maximum speed of not less 3560 RPM.

2. The fire pump shall be a horizontal base mounted, split case, bronze fitted, single stage, double suction centrifugal unit, or vertical in-line type, as indicated on the drawings.

3. The electric driver shall be a horizontal mounted, open drip proof ball bearing type, AC induction squirrel cage motor, wound for 460 volts-3 phase-60 cycles. Locked rotor currant shall not exceed the values specified in NFPA Standard 20.

4. Casing shall be of cast iron having a minimum tensile strength of 35,000 pounds. Bearing housing supports, suction and discharge flanges shall be integrally cast with the lower half of the casing. Removal of the upper half of the casing must allow the rotating element to be removed without disconnecting the suction and discharge flanges.

5. Impellers shall be of the enclosed type of vacuum cast bronze. Impellers shall be dynamically balanced, keyed to the drive shaft and held in place with threaded shaft sleeves.

6. The fire pump shaft shall be made of SAE 1045 steel or equal, accurately machined to give a true running rotating element. The shaft shall be protected by bronze sleeves which shall be key locked and threaded so that the sleeves tighten with the rotation of the shaft. A gasket shall seal between the impeller hub and the shaft to protect the pump shaft.

7. The fire pump shall be equipped with renewable casing rings so designed that hydraulic pressure will seat the rings against a shoulder in the pump case around the full periphery of the wearing ring. The wearing ring will be locked by dowling to prevent rotating. The rotating element shall use heavy duty grease lubricated ball bearings and shall be equipped with water slingers. Bearing housings shall be so designed to flush the lubricant through the bearing.

8. All packed pumps shall be provided with a latern ring connected to the pressure side of the fire pump by cored passage in the parting flange of the pump. Stuffing boxes shall be equipped with split packing glands designed for the easy removal for packing inspection and maintenance.

9. The fire pumping unit shall include the following accessories:

    a. Eccentric tapered suction reducer

    b. Concentric tapered discharge increaser

    c. Coupling guard

    d. Hose valves

    e. Caps and chains

    f. Hose valve header

    g. Pressure gauges

h. Circulation relief valve

i. Automatic air release valve

j. Balldrip valve

10. The fire pump motor shall be completely assembled, wired and tested by the manufacturer before shipment from the factory. The fire pump, controller(s) and all accessories shall be purchased under a unit contract. The pump shall be given a complete performance test with Positive Suction Pressure. Certified performance curves for both conditions shall be prepared and submitted for approval prior to shipment. The pump shall also be hydrostatically tested to twice the shutoff pressure, but in no case less than 250 psi.

11. The fire pump manufacturer shall assume unit responsibility and shall provide the services of a factory trained engineer to supervise the fire pump installation and also be available to conduct final field testing and acceptance.

2.10 FIRE PUMP CONTROLLER

A. The fire pump controller shall be of the combined manual/automatic type equipped with a solid state soft start starter. The controller shall be a completely factory assembled, wired unit, specifically meeting the requirements of NFPA Standard 20 and the National Electrical Code. The controller shall be UL listed and FM approved and supplied in a NEMA Type 3R enclosure. The fire pump controller shall be tested by the manufacturer before shipment from the factory and shall be identified as A Fire Pump Controller.

B. Limited-service controllers are not permitted.

C. Provide minimum run timer to prevent short cycling.

D. The fire pump controller shall be provided with digital readouts of the voltage of each phase, amperage of each phase, and frequency.

E. The fire pump controller shall monitor [isolation switch open on secondary source, secondary source operation,] fire pump running, loss of phase or line power, and phase reversal. Alarms shall be individually displayed on the front of the fire pump controller by lighting of visual lamps. The fire pump controller shall be equipped with terminals for remote monitoring of secondary power operation, pump running, loss of power and phase reversal.

F. The fire pump controller shall be provided with voltage surge arrestors installed in accordance with NFPA 20.

G. The fire pump controller shall be equipped with an USB port for information download. The controller shall be provided with a minimum 3,000 events recorder.

H. The fire pump controller shall be equipped with an integral automatic transfer switch. The automatic transfer switch shall be factory assembled and packaged as a unit with the fire pump controller. See specification section 263600 for additional automatic transfer switch requirements.

I. The controller shall have both an isolating switch and a circuit breaker that are motor rated and capable of interrupting the motor locked rotor current. The isolation switch and circuit breaker assembly shall be mechanically interlocked to operate with a single externally operated handle, with the enclosure door open or closed. The operating assembly shall also be mechanically interlocked to the enclosure door.

J. The circuit shall be of a type to accommodate a short circuit potential of not less than 100,000 amperes RMS at [480 volts]. The circuit breaker trip functions shall be self- contained within the circuit breaker case and not require additional current transformers or voltage sources to accomplish the trip function. The breaker trip curve adjustments shall be capable of being field tested to verify actual pick-up, locked rotor, and instantaneous trip points, after field installation, without disturbing line or load wiring.

K. The complete assembly shall be listed for fire pump service.

L. An emergency power disconnect/isolating switch shall be furnished, motor horsepower rated and capable of interrupting the motor locked rotor current. The switch shall be mechanically interlocked with the enclosure door, and operated by a single externally operated handle with the enclosure door open or closed. An auxiliary contact from the switch shall be provided to prevent starting of the emergency generator when the main fire pump controller is being serviced.

M. The controller shall have a front mounted "Power On" pilot light, a "Start" and "Stop" push-button, and an "Emergency Run" mechanism. The "Power On" pilot light shall indicate loss of control transformer power as well as line power. An FTA200C factory built-in alarm system shall be provided, giving an audible alarm for "Pump Running" or "Power Failure", and a visual alarm for "Supervisory Power Failure". Additional power failure and pump running alarm contacts shall also be wired to terminals for remote alarm in central fire alarm panel provided by Division-26.

N. A pressure switch shall be provided and shall be adjustable. The combined pressure settings, and a minimum differential of 6 psi. A minimum running period timer shall be provided.

O. Where required by the Owner's insurance carrier, the controller shall be configured for manual shut-down only. The contractor shall verify the requirement and configure the controller accordingly.

P. The fire pump controller shall be manufactured by Master, Firetrol or Sylvania.

2.11 JOCKEY (MAKE-UP) PUMP

A. Pump shall have minimum capacity and electrical characteristics as follows: 5 to 8 GPM, 178 psi and 480 volt, 3 phase.

B. Pump shall be equipped with mechanical seals and open drip proof motor.

C. Control panel in a NEMA 3R enclosure, shall include fusible disconnect switch, magnetic A-T-L starter, control transformer, H-O-A selector switch, pilot light and necessary circuitry to provide automatic start and stop from pressure switch; pressure relief valve and pressure gauges shall be provided in system.

2.12 PRESSURE SENSING LINE

A. The fire pump controller and jockey pump controller shall be provided with completely separate pressure sensing lines in accordance with NFPA 20.

2.13 BACKFLOW PREVENTER (FIRE PROTECTION)

A. Provide double check (detector) assembly consisting of two independently operated check valves, two resilient wedge gate valves and bypass assembly. Working pressure shall be a minimum of 175 psi (1200 kPa). Flange dimension shall be in accordance with AWWA Class D. The entire assembly, including shutoff valves, shall be UL, FM, and ASSE approved.

B. Where hydraulic calculations require a reduction in system pressure loss to meet desired conditions, size of backflow preventer shall be increased as required to reduce system losses. Backflow preventer size shall not be less than the connected line size indicated.

C. Backflow preventer assembly shall be an AMES 3000 SS (Silver Bullet) or equivalent. Pressure losses shall not exceed the documented flow characteristics of the AMES 3000 SS.

D. Contractor shall verify code compliance of a double check assembly versus a reduced pressure principle backflow preventer. Should the local authority require a reduced pressure type, the reduced pressure assembly shall be as manufactured by AMES or equivalent.

E. Backflow preventer shall be installed by a certified plumbing contractor in accordance with the local plumbing authority.

PART 3 - EXECUTION

3.1 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, installation of piping shall leave adequate space for work of all other trades.

1. Deviations from approved "Working Plans" for sprinkler piping require written approval of the authority having jurisdiction. Written approval shall be on file with the Architect prior to deviating from the approved "Working Plans."

B. Install sprinkler piping to provide for system drainage in accordance with the most current edition of NFPA 13.

C. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Branch takeoffs to sprinkler heads shall occur from the top of sprinkler branch piping.

D. Install unions in pipes 2 inch (50 mm) and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using roll-grooved mechanical couplings.

E. Install flanges on valves, apparatus, and equipment having 2-1/2 inch (65 mm) and larger connections, unless ductile iron with grooved ends.

F. Hangers and Supports: In addition to the requirements specified in the Division-22 Section "Hangers and Supports for Plumbing Piping and Equipment," comply with the requirements of the most current editions of NFPA 13 and NFPA 14. Hanger and support spacing and locations for piping joined with roll-grooved mechanical couplings shall be in

accordance with the roll-grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with the most current edition of NFPA 13.

G. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation.

H. Provide mechanical sleeve seals at pipe penetrations in basement and foundation walls and penetration seals at openings in fire rated walls, floors and ceilings. Refer to Division-22 Section "Piping Specialties for Plumbing Systems" for description and installation requirements.

I. Install test connections sized and located in accordance with the most current edition of NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.

J. Install pressure gage on the riser or feed main at or near each test connection. Provide gage with a connection not less than 1/4 inch (6 mm) and having a soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and where they will not be subject to freezing.

K. Piping passing through areas exposed to freezing conditions shall be protected against freezing by insulated coverings, frostproof casings or other reliable means capable of maintaining a minimum temperature of 40°F (4°C). All sprinkler piping, heads, fittings, etc. shall be installed on "warm" side of insulation. Insulation shall be tight with no open joints. Piping shall not touch or be run immediately adjacent to building structural steel. Prior to installing piping in areas exposed to freezing, the contractor shall notify the architect or owner's representative.

3.2 PIPE JOINTS

A. Welded Joints: AWS B2.1, Level AR-3.

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.

2. Align threads at point of assembly.

3. Apply appropriate tape or thread compound to the external pipe threads.

4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.

5. Damaged Threads: Do not use pipe with threads which are stripped, chipped, corroded, or otherwise damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

D. Mechanical Roll-Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings.

E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.3 VALVE INSTALLATIONS

A. General: Install fire protection specialty valves, fittings, and specialties in accordance with the manufacturer's written instructions, the most current editions of NFPA 13 and 14, and the authority having jurisdiction.

B. Gate Valves: Install supervised-open gate valves so located to control all sources of water supply except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Division-22 Section "Identification for Plumbing Piping and Equipment" for valve tags and signs.

C. Install check valves in each water supply connection.

D. Siamese Installations:

1. Install automatic drip valves at the check valve on the fire department connection to the mains.

2. Install mechanical sleeve seal at pipe penetration in outside walls.

3.4 SPRINKLER HEAD INSTALLATIONS

A. In areas with acoustical tile ceilings, sprinkler heads shall be installed in the center of the ceiling grid.

B. Use manufacturer supplied tools to prevent damage during installations and as required to maintain UL listed/FM approval.

C. Sprinkler Heads: Fusible link type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal 1/2 inch (13 mm) discharge orifice, for "Ordinary" temperature range.

D. Provide high temperature sprinkler heads in equipment spaces where pressure and temperature relief valve(s) are to be installed.

E. Provide quick response sprinkler heads throughout the building.

F. For fire pump applications, all sprinkler heads shall be 250 psi (1710 kPa).

G. Provide NFPA approved sprinkler head guards in all areas subject to potential damage. Sprinkler head guards shall be provided in the following areas and other similar type spaces subject to potential damage: gymnasiums, multi-purpose rooms, fitness areas, activity rooms, mechanical rooms, electrical rooms, etc.

3.5 BACKFLOW PREVENTER

A. Install backflow preventer assemblies in accordance with UL, FM, and ASSE standards, as well as the local plumbing code and the local fire protection authority having jurisdiction.

3.6 FIRE PUMP AND JOCKEY PUMP CONTROLLER

A. Install fire pump controller and jockey pump controller as required by NFPA 20 and NFPA 70.

B. For emergency generator applications, control conductors installed between the transfer switch and the generator shall be as follows:

1. Control wire installation shall comply with NEC Article 695.14 (F).

2. The control conductors shall be kept entirely independent of all other wiring and shall meet the conditions of NEC Article 695.14 (F).

3. The integrity of the generator remote start circuit shall be monitored

for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

3.7 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping systems in accordance with the most current edition of NFPA 13.

B. Test and inspect fire pump systems in accordance with the most current edition of NFPA 20.

C. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system.

END OF SECTION 210110

SECTION 22 0100 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. Unless otherwise modified, provisions of General Conditions, Supplementary Conditions and Division-01 govern work under the Plumbing Divisions.

B. Contract drawings for plumbing work are diagrammatic, intended to convey scope and general arrangement. Contractor shall review and coordinate routing of new work to clear existing piping, electrical, structure, etc. at no cost to the Owner. All dimensions of existing conditions shall be considered approximate (for information only). All dimensions shall be verified prior to construction.

C. Contract Document Interpretation/Discrepancies:

1. Should the Contractor discover any discrepancies or omissions on the drawings or in the specifications, he shall notify the Architect/Engineer (A/E) of such conditions prior to the bid date. Otherwise, it will be understood that the drawings and specifications are clear as to what is intended and shall be as interpreted by the A/E.
2. In addition, should any contradiction, ambiguity, inconsistency, discrepancy or conflict appear in or between any of the Contract Documents, the Contractor, shall, before proceeding with the work in question, notify the A/E and request an interpretation. In no case shall he proceed with the affected work until advised by the A/E.
3. If the Contractor fails to make a request for interpretation of discrepancies or conflicts in the drawings or specifications, no excuse will be accepted for failure to carry out the work in a satisfactory manner, as interpreted by the A/E. In all cases, the Contractor will be deemed to have estimated the most stringent materials and methods (i.e. the highest quality materials and most expensive manner of completing the work) unless he has requested and obtained written authorization as to which methods or materials will be required.
4. Each and every trade or subcontractor will be deemed to have familiarized himself with all drawings of this project, including Site/Civil, Architectural, Structural, Mechanical, Electrical, Information Technology, etc. so as to avoid coordination errors, omissions, and misinterpretations. No additional compensation will be authorized for alleged errors, omissions, and misinterpretation, whether they are a result of failure to observe these requirements or not.

D. The complete set of Architectural, Structural, Civil, Mechanical, and Electrical drawings and specifications apply to this work.

1.2 SCOPE

A. The work in Division-22 includes furnishing and installing the plumbing systems complete and ready for satisfactory service.
B. Requirements specified govern work in all sections of Division-22.

1.3 REFERENCES

A. References to standards, codes, catalogs and recommendations are latest edition in effect on date of invitation to bid.
B. Refer to applicable contract drawings, specifications and addenda pertaining to other divisions for conditions affecting work.
C. Refer to Division-01 for description of alternates.
D. Refer to Division-01 for description of allowance items.
E. Refer to Division-01 for description of base bid items.
F. Refer to Division-01 for description of demolition items.

1.4 DEFINITIONS

A. Following are definitions of terms and expressions used in this Division:
   1. "Approve" - to permit use of material, equipment or methods conditional upon compliance with contract document requirements.
   2. "Concealed" - hidden from normal sight; includes work in crawl spaces, above ceilings, and in building shafts.
   3. "Directed" - directed by Engineer.
   4. "Equal, equivalent" - possessing the same performance qualities and characteristics and fulfilling the same utilitarian function.
   5. "Exposed" - not concealed.
   6. "Indicated" - indicated in Contract Documents.
   7. "Piping" - includes pipe, fittings, valves, supports and accessories comprising a system.
   8. "Provide" - furnish and install.
   9. "Removable" - detachable from the structure or system without physical alteration of materials or equipment or disturbance to other construction.
   10. "Review" - limited observation or checking to ascertain general conformance with design concepts and general compliance with contract document requirements. Such action does not constitute a waiver or alteration of the contract requirements. Verification of quantities and dimensions shall be the responsibility of the Contractor.
   11. "Appurtenances" - a device or assembly installed in the referenced system which performs some useful referenced function in the

operation, maintenance, servicing, economy or safety of the system. Some examples include, but are not limited to aerators, anchors, supports, gauges, backflow preventers, expansion tanks, filters, flow controls, heat exchangers, interceptors, meters, pressure reducing valves, relief valves, dampers, separators and similar devices.

12. "Record Documents" - drawings, plans and specifications that indicate the nature and location of work reported by Contractors, but not verified by Consultant. Record documents cannot be considered reliable; as they are based on information reported by the Contractor only and is not verified by the Architect or Engineer (A/E).

1.5 RIGGING REQUIREMENTS

A. Prior to bidding, the Contractor shall verify that all equipment can be physically rigged to the proposed location without disturbance or dismantling of any existing or new physical obstacles. Should the rigging of any new equipment appear to be an issue, the Contractor shall inform the Architect or Engineer (A/E) seven (7) days prior to the bid date that the rigging of the new equipment may present a problem. Otherwise, the Contractor shall, in accordance with the manufacturer's approval and without voiding warranties and/or certifications, have the equipment "broken down" into sections as required to install the equipment in its proposed location without disturbance or dismantling of any existing or new physical obstacles.

B. Failure to inform the Architect or Engineer (A/E) seven (7) days prior to the bid of any rigging problems will result in the Contractor accepting full responsibility for all modifications to the equipment or the physical obstacles required to install the equipment in its proposed location without additional cost to the Owner.

1.6 CONTRACTOR'S INSTALLATION DRAWINGS

A. Prior to fabrication and installation, submit shop drawings (min. scale - 1/4" = 1' - 0") illustrating all plumbing piping, lighting fixtures, cable tray, conduit, expansion loops, supports, alignment guides and fire protection coordinated with each other and with the structure. Installation drawings shall be reviewed by Owner's representative prior to fabrication and installation of any new work and prior to the ordering of any plumbing equipment.

B. Should the Contractor not provide the coordinated installation drawings required above, the following shall apply:

1. The Contractor shall accept full and absolute responsibility for the coordination of all project materials and equipment to be installed as indicated on the contract documents.
2. Proposed change orders and/or time extensions will not be

accepted for any additional work that results from coordination related changes.

3. A credit shall be issued to the Owner for the value of the coordinated installation drawings; the value of the credit to the Owner shall be as determined by the A/E.

C. Computer (CADD) files of mechanical drawings (HVAC, plumbing, etc.) will not be made available to the Contractor for use in the preparation of coordinated drawings, shop drawings or any other use.

1.7 MATERIAL, EQUIPMENT AND SUBSTITUTION REQUIREMENTS

A. Use products of one manufacturer where two or more items of same kind of equipment are required.

B. Materials and equipment shall have a record of two (2) years successful field use.

C. Where a specific manufacturer is listed on the drawings, that manufacturer shall be considered the basis of design for that particular item of equipment. Only the basis of design manufacturer has been verified to meet the project requirements (i.e. dimensions, weights, service clearances, electrical requirements, etc.).

D. Where the drawings and/or specifications indicate more than one manufacturer for a particular item of equipment, only those listed may submit products and services to be included in the work; manufacturers other than those listed will not be acceptable. Should the contractor choose to use one of the specified manufacturers other than the basis of design, it shall be the responsibility of the contractor to verify that the equipment meets all project requirements including, but not limited to, verification of all dimensions, weights, service clearances, electrical requirements, etc. All changes incurred shall be the responsibility of the contractor and shall be provided at no additional cost to the owner.

E. Substitutions must be submitted for consideration seven (7) days prior to the original bid date. Consideration of substitutions shall be at the sole discretion of the Engineer. Substitution submittals shall include all information required in the "Submittals" paragraph of this specification section, as well as all other requirements indicated through the Division-22 specifications. Substitutions will not mitigate, in any way, the Contractor's responsibility in complying with the coordination, contract requirements or design intent. Any additional electrical, structural or special requirements, etc. shall be the responsibility of the Contractor. Also, any additional cost incurred as a result of substitution shall be the responsibility of the Contractor.

F. Nameplate: For each piece of power operated plumbing equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

G. Where items of equipment are indicated as Base Bid on the bid form include in the Bid price the cost of providing the equipment upon which the specification is based. In addition, submit with bid for Owner's consideration the amount to be added or deducted from the base bid for other listed manufacturers' equipment. Owner will advise Contractor within forty-five (45) days after award of contract of his selection.

1.8 MATERIAL AND EQUIPMENT LIST

A. Within thirty (30) days after award of the contract, submit for Engineer's review a list of subcontractors' and manufacturers' names for items proposed for this project.

1.9 SUBMITTALS

A. Where the drawings and/or specifications indicate more than one allowable manufacturer for a particular piece of equipment and/or product, only those manufacturers indicated may submit products and services to be included in the work. Unless otherwise indicated, manufacturers other than those listed will not be acceptable.

B. Submit shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review.

C. Shop Drawings: Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment. Include equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, drawings shall be revised to show acceptable equipment and be resubmitted. All equipment and/or products shall be submitted by an authorized factory representative of that particular product.

D. Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

E. Standards Compliance: When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA),

American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted to the Engineer for review. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable testing. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for review. The certificate shall identify the manufacturer, the product, and the referenced standard and shall simply state that the manufacturer certifies that the product conforms to all requirements of the project specification and of the referenced standards listed.

F. Contractor shall thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission and coordinate installation requirements for equipment submitted, including a) the verification of equipment weights relative to the existing and/or new structural support system and b) the verification of equipment dimensions relative to existing and/or new architectural conditions. Contractor shall be responsible for correctness of all submittals.

G. Submittals will be checked only for general conformance with the design concept and are subject to the original contract documents, as well as any corrections and comments noted. Comments noted, if any, will not be considered a complete list of all omissions, deviations and corrections necessary to meet the requirements of the contract documents. The contractor will be responsible to confirm that the final product and installation will be in conformance with the contract documents in their entirety, including the responsibility to fully coordinate all work with other trades and to confirm the correctness of dimensions, quantities, and capacities. Submittal review does not authorize or constitute a change to the contract requirements and does not release the contractor of responsibility to conform to the contract requirements. Requirements of the contract are not waived by review of any and all substitutions. The contractor must fulfill the terms of the contract.

H. Compliance Review Form: Each equipment submittal must include a Compliance Review Form formatted as follows:

1. Section 1: Certify that the submittal is in complete compliance with the plans and specifications, except for the numbered and footnoted deviations and exceptions as defined herein. Deviations or exceptions taken in a cover letter or by contradiction or omission shall not constitute a release from the requirement that the equipment be in complete compliance with the plans and

specifications.

2. Section 2: Provide a detailed paragraph by paragraph annotation of the specification with an individual "C", "D", or "E" noted in the margin, as follows:
   a. "C" shall mean compliance with no exceptions. Provide a numbered footnote (i.e. C1, C2, C3, etc.) for each comment or clarification.
   b. "D" shall mean compliance with deviations. For each deviation, provide a numbered footnote (i.e. D1, D2, D3, etc.) with a detailed explanation of how the intent of this specification is to be satisfied.
   c. "E" shall mean exception. The equipment offered is not in compliance with the specifications. For each exception, provide a numbered footnote (i.e. E1, E2, E3, etc.) with a detailed description of the exception.

I. Electronic Submittals: Should the contractor elect to submit electronic shop drawings/submittals, the procedure shall be as follows:
   1. Provide a transmittal with the electronic shop drawing/submittal indicating that the document was transmitted electronically. Transmittal shall also include verification of the contractor's review indicating compliance with the contract documents in accordance with paragraph 1.09.F of this section.
   2. Sequentially number all pages on the electronic shop drawing/submittal. The total number of pages shall be reflected in the transmittal.
   3. Submittal review comments shall be transmitted electronically. Large documents will be scanned with comments as necessary and returned electronically.
   4. All shop drawings such as, but not limited to: coordination drawings, ductwork shop drawings, fire alarm drawings, ductbank layouts, etc. shall be submitted in hard copy, full size format.
   5. Provide hard copy of the shop drawing/submittal for each of the Operations and Maintenance Manuals.
   6. Failure to comply with the above will result in the submittal being returned and marked "Not Reviewed".

J. Submittals will be reviewed for general compliance with design concept in accordance with contract documents. Dimensions, quantities, weights, or other details will not be verified by the A/E; this is the responsibility of the Contractor.

K. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

L. Review Period: BKM shall be allotted two (2) weeks for the processing, review and return of all submittals. It shall be incumbent upon the Contractor to include this time period in their schedule.
   1. Resubmittals: BKM shall be allotted an additional two weeks (14 days) for the review of each resubmittal. Again, it shall be the

Contractor's responsibility to submit the appropriate materials in a timely fashion.

2. Contract Extension: No extension in contract time will be authorized as a result of the timeline addressed above.

M. Submittal Identifications:
1. Place a permanent label or title block on each submittal for identification.
2. Indicate name of firm or entity that prepared each submittal on label or title block.
3. Provide a space approximately 4 by 5 inches on label or beside title block to record contractor's review and approval markings and action taken by A/E.
4. Include the following information on label for processing and recording action taken:
   a. Project name
   b. Date
   c. Name and address of A/E
   d. Name and address of contractor
   e. Name and address of subcontractor
   f. Name and address of supplier
   g. Name of manufacturer
   h. Unique identifier, including revision number
   i. Number and title of appropriate specification section
   j. Drawing number and detail references, as appropriate
   k. Other necessary identification
   l. Example: 220700-01-0
      1) 220700 references the spec section
      2) 01 indicates this is the first submittal from this spec section
      3) 0 indicates this is the original submittal (where 1 would indicate this is the first re-submittal)

N. The engineer will provide a maximum of two (2) submittal reviews per equipment submittal; the initial review plus one (1) re-submittal. Should the re-submittal be returned "Not Acceptable" or "Revise and Resubmit", the contractor shall choose one of the following courses of action:
1. Provide the exact manufacturer and model indicated in the contract documents as the basis of design, or
2. Reimburse the engineer for all additional review time required to achieve a submittal review from the engineer of "No Exceptions Taken."
3. Should the contractor choose option 2 above, the engineer shall be reimbursed at an hourly rate of $175 per hour with payment due prior to the return of the final submittal. In addition, the contractor shall accept complete responsibility for all delays resulting from the submittal review process extending beyond two (2) reviews per equipment submittal.

O. Resubmittals: Resubmittals shall comply with paragraph 1.09 of this section

and the following additional requirements.

1. Resubmittals shall include a written response to each submittal comment. Provide a detailed comment by comment annotation of the submittal review comments with an individual "C", "D", or "E" as follows:
   a. "C" shall mean compliance with no exceptions. Provide a numbered footnote (i.e. C1, C2, C3, etc.) for each comment or clarification.
   b. "D" shall mean compliance with deviations. For each deviation, provide a numbered footnote (i.e. D1, D2, D3, etc.) with a detailed explanation of how the intent of this specification is to be satisfied.
   c. "E" shall mean exception. The equipment offered is not in compliance with the specifications. For each exception, provide a numbered footnote (i.e. E1, E2, E3, etc.) with a detailed description of the exception.

1.10 MANUFACTURER'S RECOMMENDATIONS

A. Installation procedures are required to be in accordance with the recommendations of the manufacturer of the material being installed.

1.11 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

1.12 SAFETY REQUIREMENTS

A. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts located so that any person can come in close proximity thereto shall be fully enclosed or properly guarded in accordance with OSHA. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein. Items such as catwalks, ladders, and guardrails shall be provided where required for safe operation and maintenance of equipment.

1.13 WORKMANSHIP

A. Remove and replace, at no extra cost, all work not orderly, reasonably neat, or workmanlike.
B. Coordinate all work and cooperate with other trades to facilitate execution of work.

1.14 SITE EXAMINATION/EXISTING CONDITIONS VERIFICATION

A. Failure to visit site and become familiar with existing conditions prior to bidding will not relieve the Contractor of responsibility for complying with the Contract documents.

B. Contractor shall field verify existing services and direction of flow of piping prior to connection. Existing plumbing identification shall not constitute proper verification of service or direction of flow.

1.15 REGULATIONS AND PERMITS

A. Comply with all applicable codes and regulations.

B. All equipment provided shall be in accordance with all applicable local, state, and federal codes, guidelines and standards, as well as the authority having jurisdiction. Equipment and installation shall be in compliance with all applicable energy codes including the most current version of ASHRAE Standard 90.1.

C. Obtain and pay for all required permits.

1.16 UTILITY CONNECTIONS

A. Area connection charges for water and sewers will be paid by the Owner.

B. Application for water meter will be made by the Owner.

C. Contractor shall include an allowance as identified in Division-01 for providing water meter, vault, and connection to main by Bureau of Water Supply.

D. Gas Service: Arrange for installation of gas meter and connection to main by gas utility. Pay charges, if required. Gas main extension charges, if any, will be paid by the Owner.

1. All gas installations on and at the Owner's property/building must conform to BGE's construction and installation requirements. Gas meter installation requirements shall include, but not be limited to, the following:
    a. Meters shall not be installed within three feet (900 mm) of any equipment with an open flame or subject to electric arcing.
    b. Meters shall not be installed in areas where the clearance from the front of the meter to an opposite wall is less than two feet (600 mm).
    c. Gas meters shall be installed such that there are four feet (1200 mm) of clearance from the front of the meter to a wall directly opposite where an electric meter is located.
    d. Outside meters shall not be installed within three feet (900 mm) of an opening used for ventilation.
    e. Meters shall not be installed in unventilated spaces.
    f. Meters shall not be installed in places where they may be subject to damage (driveways, sidewalks, etc.) unless suitable traffic protection is provided.

g. Contractor shall provide a concrete pad for installation of the gas meter. Pad requirements shall be as required by the gas utility company.

2. Gas conduit installation requirements shall be as follows:
   a. The following gas conduit specification is acceptable for use on BGE system: UL Schedule 40 DB 60.
   b. Conduit for gas services (not mains) is required whenever installed in common with electric ducts.
   c. Gas conduit shall not exceed one 45-degree (.785 Radians) bend, and must be terminated a minimum of five feet (1500 mm) from all buildings/structures. No 90-degree (1.57 Radians) bends are permitted.
   d. Only one gas service per conduit is permitted.
   e. Gas conduits will be concrete-encased.
   f. Installation of gas piping into electrical conduit bank is prohibited.
   g. PVC conduit (minimum 4") (minimum 100 mm), solid wall, not split) may be used as a sleeve installed in advance of paving to facilitate future installation of small size (2" and smaller) (50 mm and smaller) gas services where casing is not required. The ends of the sleeve should not be sealed after insertion of the carrier pipe to avoid containment of gas in case of a gas leak. However, the end of the sleeve on a service line nearest the building should be sealed after installation of the carrier pipe and the opposite end of the sleeve left open.
   h. Lengths of continuous runs for gas ducts shall not exceed 450 feet (135 m).
   i. Mechanical joints on gas services are not allowed inside of conduit. Open trench space provision must be made to allow BGE room to make these connections.
   j. Marker tape is required, and must be 12" (300 mm) minimum above all gas conduits.
   k. Required minimum depth of conduits from final grade to top of conduit is 24" (600 mm).
   l. Required vertical separation for gas conduit crossing foreign structures is 12" (300 mm).
   m. Horizontal separation between gas conduit and electric conduit, in common trench, should be 12" (300 mm) minimum.

1.17 CUTTING AND PATCHING

A. Unless otherwise directed, do all cutting and patching. Damaged work, including fireproofing and waterproofing shall be repaired by skilled mechanics of the trade involved.

B. Do not cut walls, floors, roofs, reinforced concrete or structural steel without structural Engineer's permission. Install services without affecting

reinforcing steel.

C. In precast concrete plank drill all holes with a Carboloy tipped drill. Follow instructions of structural Engineer. Cut no reinforcing bars.

1.18 LINTELS

A. Under this Section provide all lintels not provided elsewhere which are required for openings for the installations of mechanical and plumbing work. Lintels shall meet the requirements of the structural sections.

1.19 CLEANING UP

A. Keep premises free from accumulation of debris.
B. Remove tools, scaffolding, surplus material, debris, and leave premises broom clean.
C. On discontinuance of part of the work, place all debris in containers and promptly remove them from the Owner's property.
D. Leave all areas broom clean.
E. Final clean-up shall be performed.

1.20 AREAS REQUIRING SPECIAL FINISHES/PAINTING

A. In kitchens, cafeterias, dining rooms, serving pantries and utility rooms [polish chromium or nickel plate] [paint as specified under Painting] all exposed and uninsulated piping including valves, traps, strainers and appurtenant items; and exposed electrical work including conduit, boxes, switches starters and disconnects. Finish shall not be applied to nameplates, pushbuttons. Stainless steel housing and plates require no plating or paints.
B. Provide surface preparation, priming and painting of all mechanical room floors to provide a smooth, cleanable surface. Primer and paint shall be appropriate for concrete slab surfaces. Where painting over existing surfaces or coatings, follow manufacturer's recommendations for surface preparation, priming and painting. Architectural section "Painting" shall govern the painting installation. Color shall be selected by Architect.

1.21 PROTECTION

A. Protect mechanical and electrical material and equipment from the elements or other injury as soon as delivered on premises. Protect fixtures as soon as they are set. Board over water closets and post notices prohibiting their use.
B. Cap or plug openings in equipment, piping and conduit systems to exclude dirt and other foreign material. Rags, wool, cotton, paper, waste or similar materials shall not be used for plugging.
C. Contractor shall protect all existing mechanical, electrical and

architectural equipment, materials, finishes, etc. located within or adjacent to the work environment. Contractor shall be responsible for restoration of all existing mechanical, electrical and architectural items to remain. All equipment to remain must be restored to its pre-existing condition prior to the start of work. Restoration and/or replacement shall be at no cost to the Owner.

D. Contractor shall provide temporary cooling and heating as required to protect all construction materials from the potential adverse effects of high or low temperature and humidity. Upon delivery of ceiling and other finish materials to a location within the building, environmental conditions in all spaces where the materials will be either stored or installed shall be permanently maintained at 75˚F (+2˚F) and 50% RH (+5%). Should the HVAC include a reheat system, the reheat system shall be energized to provide temperature and humidity control whenever the HVAC system is energized. Contractor shall pay for all utility, fuel, operational, maintenance and repair costs associated with providing the environmental conditions indicated above until the owner accepts occupancy of the building.

1.22 PIPE TESTING

A. Prior to the balancing of systems, the mechanical contractor shall air and/or hydrostatically test the following systems in accordance with the latest ASME B31 (ASME Code for Pressure Piping) and NFPA requirements.
   1. Air Test:
      a. Air, Gas and Vacuum
   2. Hydrostatic Test:
      a. Domestic Water

B. Pressure tests shall also be performed prior to the installation of all insulation materials.

C. Hydrostatic Test: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed, wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
   1. Required test period is four (4) hours.
   2. Hydrostatically test each piping system at 150% of operating pressure indicated, but not less than 100 psi (690 kPa) test pressure.
   3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds less than one percent (1.0%) of test pressure.
   4. Upon completion of roughing-in and before setting fixtures, the entire new domestic water system shall be tested. Where a portion of the water piping system is to be concealed before completion,

this portion shall be tested separately in a manner described for the entire system.

5. Prior to testing, verify the pressures listed above are in accordance with the latest ASME B31 code and NFPA. Should a discrepancy exist between the ASME B31 code, NFPA, and/or the pressures indicated above, contact the Engineer prior to testing.

D. Air Test:
   1. Air, gas and vacuum piping shall be air tested at 200 psi (1380 kPa).
   2. Prior to testing, verify the pressures listed above are in accordance with the latest ASME B31 code and NFPA. Should a discrepancy exist between the ASME B31 code, NFPA, and/or the pressures indicated above, contact the Engineer prior to testing.

E. Sanitary and Storm Water Piping Systems:
   1. All soil, waste, vent and storm water piping shall be tested by the Contractor and reviewed by the Architect before acceptance. All piping located underground shall be tested before backfilling. The costs of all equipment required for tests are to be included under the contract price.
   2. The entire new drainage system and venting system shall have all necessary openings plugged and filled with water to the level of the highest vent stack above the roof. The system shall hold this water for four (4) hours without showing a drop in water level. Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except a vertical stack 10 feet (3000 mm) above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure.

F. Drain test water from piping systems after testing and repair work has been completed.

G. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

1.23 CLEANING OF SYSTEMS

A. After satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers and other accessory items, thoroughly clean all systems. Blow out and flush piping until interiors are free of foreign matter.

B. Flush piping in recirculating water systems to remove all cutting oil, excess pipe joint compound and other foreign materials. Furnish necessary temporary pumping equipment to thoroughly clean the water piping. Do not use any system pump until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system

components. After cleaning operation, final flushing and refilling the residual alkalinity shall not exceed 300 parts per million. Work shall be performed or supervised by a qualified water treatment service company with personnel skilled in the safe and proper use of chemicals and in testing procedures. After completion, submit a certificate of completion to Engineer stating name of the service company used.

C. Leave strainers and dirt pockets in clean condition.

D. Should any system become clogged with construction refuse after acceptance, the contractor shall pay for all labor and materials required to locate and remove the obstruction and replace and repair work disturbed.

E. Thoroughly clean plumbing fixture using non-scratching cleaners. Polish chromium plated work.

F. Leave all systems clean, and in complete running order.

G. Disinfect potable water systems as prescribed by local code. Take precautions to avoid use of fixtures during disinfection period.

H. Equipment that has been subjected to the elements shall be cleaned of all rust, dirt and debris and repainted to match original finish.

1.24 FUNCTIONAL PERFORMANCE TESTING AND VERIFICATION

A. General: In addition to the tests required during and after installation of all mechanical systems, as well as any other formal commissioning requirements, the Contractor shall perform functional performance tests to verify that all systems are designed, installed, calibrated and adjusted to perform as required in the Contract.

B. Comply with all applicable specification sections including, but not be limited to, "Basic Plumbing Requirements", "Testing, Adjusting and Balancing", "Automatic Temperature Controls" and "Commissioning", where applicable.

C. Prior to functional performance testing, all indicating, recording and control devices shall be calibrated. A verification calibration report shall be provided with the final test report.

D. Provide functional performance testing to verify proper operation of each and every control sequence indicated throughout the contract documents.

E. Failure of Tests: Should any test, verification, or demonstration fail to meet the specification requirements, the component of the system causing the failure shall be repaired, replaced or readjusted. The failed test, verification, or demonstration shall then be repeated.

F. A "Functional Performance Test Verification Form" is included at the end of Section 230900. This form (electronic version is available upon request) shall be completed for all mechanical equipment provided under this contract.

G. Test Report: Upon satisfactory verification of calibration and functional performance tests, a copy of the final test results shall be bound in the

operations and maintenance manual. The final report shall also include a full compliance statement, on company letterhead, indicating that all systems are installed and functioning per the contract requirements including drawings, specifications, control sequences and accepted submittals.

H. The mechanical systems shall not be considered complete until all functional performance verification forms, calibration reports and compliance statement have been submitted and reviewed. Submit in accordance with the submittal requirements indicated elsewhere in these specifications.

1.25 OPERATING AND MAINTENANCE MANUAL

A. Submit Operation and Maintenance Manuals in three-ring binders with each section separated by tab dividers. Include protective plastic sleeves for any software or folded large documents submitted.

B. At a minimum, the manual shall contain the following:
   1. Title page
   2. Table of contents
   3. Contractor and sub-contractor contact information
   4. Supplier contact information for all plumbing equipment
   5. Copies of manufacturer's and contractor's warranty information (project and equipment) for all plumbing equipment.
   6. Submittal log for all plumbing equipment
   7. One (1) reviewed copy of each shop drawing or submittal incorporating all A/E and owner submittal review comments.
   8. Copy of inspector acceptance certificates / documents.
   9. Provide an 11 x 17 fold-out drawing of each floor plan and indicate locations of system shutoff valves.
   10. All pipe and equipment pressure test reports complete with 11 x 17 fold-out drawing, indicating all systems tested.
   11. Maintenance procedures for each item of plumbing equipment to include frequency and type of maintenance, spare parts and attic/stock list. This shall include the manufacturer's literature indicating operating and maintenance instructions, parts list, illustrations and diagrams.
   12. Valve tag chart
   13. Mechanical systems functional performance verification forms, calibration reports and compliance statement indicating that all systems are installed and functioning per the contract requirements.

C. The O & M Manuals shall be submitted to the A/E for review of general conformance.

1.26 TOOLS AND LUBRICANTS

A. Furnish and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of

equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Owner.

D. Lubricants: A minimum of one quart (.9 L) of oil, and one pound (450 g) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

1.27 FIELD INSTRUCTION

A. Upon completion of work, instruct Owner's representative in the proper operation and maintenance of the plumbing and electrical systems.

B. Instruction periods specified below shall be in addition to instruction specified for certain items elsewhere in the specifications.

C. Instructions shall be given by persons expert in the operation and maintenance and shall be for a period of not less than . . eight hour days.

D. Prepare statement(s) for signing by Owner's representative indicating date of completion of instructions and hours expended. Furnish copy of signed statement to Engineer.

E. Final demonstration of all plumbing equipment shall be recorded in DVD compatible format. Provide DVD's to the Owner.

1.28 RECORD DOCUMENTS

A. The Contractor shall maintain a record set of plumbing prints at the project site and shall indicate thereon any changes made to the contract drawings, including, but not limited to addenda, field sketches, RFI responses, supplemental drawings, sketches, etc. Where changes are made that are reflective of supplemental instructions, revisions, RFI responses, etc., the Contractor shall make clear references to those changes.

B. A separate set of neat, legible mechanical contract prints shall be kept at the project site at all times during the construction of the work for the express purpose of showing any and all changes indicated in paragraph A. above. The prints shall be marked up daily showing all changes to the original documents. The prints shall be marked up in a neat, legible manner using a red pen. Periodic review of the Record Documents will be conducted by the Owner's Representative or A/E. Should this review indicate that the Record Documents are deficient or not up to date, the Contractor shall immediately bring the documents into compliance and make the corrections

C. Upon completion of the project and before final close-out, the Contractor shall be responsible for producing a final set of record documents in electronic CADD format. One (1) set of full size prints, one

(1) CD of the electronic CADD drawings (in AutoCad and pdf format), along with the red-lined marked up field set shall be delivered to the owner upon completion. If requested, the electronic CADD documents shall be up-loaded to the owner's FTP site. The final CADD documents shall indicate in the title or revision block "RECORD DOCUMENTS" along with the date completed. The electronic format shall be compatible with the owner's preferred version of AutoCad. Coordinate with the owner before producing the CD or up-loading to the FTP site. Not acceptable are contractor installation drawings, shop drawings or multi-layers of work on a single drawing. The final as-built product shall mirror the contract bid documents using the project page layout, format and project title block.

D. Computer (CADD) files of plumbing drawings will be made available to the Contractor upon receipt of a signed waiver (available upon request). One CD will be made available to the general contractor or construction manager for distribution to the trades.

E. Should the Contractor's electronic Record Documents not be considered complete, they will be returned for completion and/or correction.

1.29 DEMOLITION

A. All demolition of existing mechanical and electrical piping, auxiliaries and equipment, shall be as specified under the Architectural "Demolition" section, of these specifications, as shown on the drawings, and as required to complete the new and renovated installations and shall be performed by the respective mechanical and electrical contractors.

B. This work shall include the disconnection and capping of existing services, relocation of certain equipment, and the removal of existing piping, wiring, fittings, equipment, including heat transfer units, plumbing fixtures, electrical controls and panelboxes, etc., not reused in the new work or required to complete the renovation work. Contractor shall note the drawings specify certain existing equipment to be reused.

C. Where supports and piping are removed, holes remaining in floors, walls and ceilings must be patched and refinished to match the adjoining original surfaces and finishes.

D. Any removed items requested by the Owner shall remain the property of the Owner. Contractor shall remove equipment and store on site as directed by the Owner. All other equipment or material shall become the property of the Contractor and shall be removed from the site. Contractor shall meet Federal EPA Laws, Regulations and Guidelines in regard to removal of asbestos insulation.

E. The contractor shall use care when performing selective building and site demolition. The contractor shall be responsible for damage inclusive of but not limited to: building finishes, lighting (interior and exterior), furniture, structure, site, utilities (above and below ground), mechanical, plumbing, telecommunications and electrical equipment / systems. Should any damage occur or should any remedial work be required, the contractor

shall be responsible to repair and or replace the damaged item(s) to the Owner's satisfaction at no additional cost. The contractor shall be responsible for surveying (including contacting Miss Utility), photo documenting and restoring the surrounding work site(s) to the original pre-demolition condition and / or to the Owner's satisfaction upon completion of the work at no additional cost.

1.30 OUTAGES

A. All plumbing outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon by the Contractor and the Owner's Representative.

B. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled at least ten (10) days in advance with the Owner's Representative. All such outages shall be performed during other than normal duty hours.

C. The Contractor shall include in his price the cost of all premium time required for outages and other work which interferes with the normal use of the building, which will be performed, in most cases, during other than normal work time and the convenience of the using agency.

1.31 LEAD FREE COMPLIANCE

A. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

1.32 LEED CERTIFICATION

A. This project is required to obtain a LEED certification. The Contractor shall provide all required LEED documentation as required to achieve the construction related LEED credits.

B. The project includes both LEED Fundamental and Enhanced Commissioning. Provide all services as required for compliance with the Fundamental and Enhanced Commissioning requirements. Coordinate with the Commissioning Agent as required. Refer to the Commissioning specification sections for additional information.

1.33 GUARANTEE/WARRANTY

A. Each Contractor shall furnish a guarantee covering all labor and materials furnished by him for a period of two (2) years from the date of final acceptance of his work, and he shall agree to repair and make good at his own expense any and all defects which may appear in his work during that time if, in the judgment of the Engineer, such defects arise from

defective workmanship and/or imperfect or inferior material.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be delivered to the Owner.

C. Within the two (2) year warranty/guarantee period, manufacturer's recommended maintenance shall be provided by the Contractor.

1.34 PIPING LEAKAGE TEST FORMS

A. Contractor shall submit piping leakage test results to the A/E within 72 hours of completed tests. Only test results that meet the specified leakage requirements shall be submitted. Piping test results shall be recorded on the "Piping Leakage Test Summary Form (Plumbing)" located at the end of this section; no other forms will be accepted. In addition, the pipe leakage submittals shall include 11x17 drawing(s) as required to clearly indicate the full extent of the piping test section (each piping test section shall be numbered and color coded).

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION

PIPING LEAKAGE TEST SUMMARY FORM
(PLUMBING)

Project Name: _____ Project Number: _____ Page ____ of ____

System Tested	Sections Tested (1)	System Operating Pressure	Test Pressure (PSI/FT-HD) (2)	Duration (3)	Pressure Drop (4)	Pass/Fail

Name of Testing Agency/Company: _____
Date of Test(s): _____
Test Conducted By (Print/Sign): _____

(1) Identified by an 11 x 17 numbered and color coded test section plan. Plan shall accompany this test report.
(2) 150% of operating pressure but not less than 100 psi , 200 psi for air-gas-vacuum, 10 ft. static head pressure or to the maximum rating of the joint. Include joint cut sheets showing their ratings.
(3) Four (4) hours minimum.
(4) Shall not exceed 0.0%.

SECTION 22 0200 - PROJECT CLOSEOUT PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This section provides a summary of the primary mechanical project closeout activities, however, this section does not attempt to address all project closeout requirements. Closeout activities referenced in this section include the following:
   1. Pressure Testing
   2. Start-up
   3. Punch-out Procedures
   4. Testing, Adjusting and Balancing
   5. Functional Performance Testing and Verification
   6. Operation and Maintenance Manuals (O & M Manuals)
   7. Demonstration and Training
   8. Record Documents
   9. Close-out Documents

B. This Section shall not supersede any other close-out section or requirements of the Contract. Refer to other Divisions of the specifications and the General Requirements of the Contract for further instructions.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PRESSURE TESTING

A. Piping: The Contractor shall perform pressure testing on all piping systems.

B. Final pressure test results shall be submitted as a separate project submittal for review and included with the Test and Balance Report. Upon review for general conformance, include all pressure tests in the O & M Manual.

C. All factory performed equipment test results shall be included in the final O & M Manuals.

D. Where re-tests were required, indicate remedial action taken and submit in test report.

3.2 START-UP

A. The Contractor shall perform start-up on each piece of mechanical equipment as specified in each section of Division-22.

B. Where indicated in each section of Division-22, the services of a factory authorized and certified technician shall be required to perform the equipment start-up. Start-up by any other organization other than as required by the manufacturer is unacceptable.

C. Start-up reports shall be provided for all equipment and be included in the final O & M Manuals.

3.3 PUNCH-OUT PROCEDURES

A. Preliminary Punch-out:

1. Prior to requesting an inspection from the Owner, Engineer, or Permit Official, the General Contractor or Construction Manager (GC or CM) shall provide a preliminary punch-out of the area in question.
2. Once completed, their punch list shall be supplied to each trade for corrections and completion. The punch list shall also be provided to the Engineer for their use.
3. Upon being informed that the trade contractors have addressed all of the outstanding items, the GC / CM shall backcheck the work and update the punch list.

B. Final Punch-out:

1. Final punch-out by the engineer shall not commence until the GC or CM has exhausted their review and has signed off on all items.
2. A copy of the sign-off shall be provided to the Engineer for their record.
3. Once the above has been completed, the Engineer shall be notified that the work is substantially complete and ready for a final punch-out.
4. Depending on the size, schedule, and project complexity, punch-outs may be requested for specific areas or systems, rather than the facility as a whole. Examples of specific requests include the following:
    a. Above ceiling
    b. Mock-ups for any repetitive installation to confirm acceptance prior to continuing (labs, dorms, offices, etc.)
    c. Equipment rooms

C. Upon completion of any and all punch lists (i.e. above ceiling, final, partial, phased, factory review, or specific item) the contractor shall provide an item by item sign-off indicating the date and who completed the item. The sign-off shall be submitted to the A/E and owner before final payment is processed. Should the contractor disagree with any item, they shall provide a written exception giving reason for review.

3.4 TESTING, ADJUSTING AND BALANCING

A. Comply with all provisions of Division-23 Section, "Testing, Adjusting and Balancing" (TAB) for the systems listed, but not limited to, the following:
   1. Domestic hot water recirc pump and associated balance valves

B. TAB reports shall be submitted as a separate project submittal for review. Upon review for general conformance, include the final TAB report in the O & M Manual.

3.5 FUNCTIONAL PERFORMANCE TESTING AND VERIFICATION

A. General: In addition to the tests required during and after installation of all mechanical systems, as well as any other formal commissioning requirements, the Contractor shall perform functional performance tests to verify that all systems are designed, installed, calibrated and adjusted to perform as required in the Contract.

B. Comply with all applicable specification sections including, but not be limited to, "Basic Plumbing Requirements", "Testing, Adjusting and Balancing", "Automatic Temperature Controls" and "Commissioning", where applicable.

C. Prior to functional performance testing, all indicating, recording and control devices shall be calibrated. A verification calibration report shall be provided with the final test report.

D. Provide functional performance testing to verify proper operation of each and every control sequence indicated throughout the contract documents.

E. Failure of Tests: Should any test, verification, or demonstration fail to meet the specification requirements, the component of the system causing the failure shall be repaired, replaced or readjusted. The failed test, verification, or demonstration shall then be repeated.

F. A "Functional Performance Test Verification Form" is included at the end of Section 230900. This form (electronic version is available upon request) shall be completed for all mechanical equipment provided under this contract.

G. Test Report: Upon satisfactory verification of calibration and functional performance tests, a copy of the final test results shall be bound in the operations and maintenance manual. The final report shall also include a full compliance statement, on company letterhead, indicating that all systems are installed and functioning per the contract requirements including drawings, specifications, control sequences and accepted submittals.

H. The mechanical systems shall not be considered complete until all functional performance verification forms, calibration reports and compliance statement have been submitted and reviewed. Submit in accordance with the submittal requirements indicated elsewhere in these specifications.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Submit Operation and Maintenance Manuals in three-ring binders with each section separated by tab dividers. Include protective plastic sleeves for any software or folded large documents submitted.

B. At a minimum, the manual shall contain the following:
   1. Title page
   2. Table of contents
   3. Contractor and sub-contractor contact information
   4. Supplier contact information for all mechanical equipment
   5. Copies of manufacturer's and contractor's warranty information (project and equipment) for all mechanical equipment.
   6. Submittal log for all mechanical equipment
   7. One (1) reviewed copy of each shop drawing or submittal incorporating all A/E and owner submittal review comments.
   8. Copy of inspector acceptance certificates / documents.
   9. Provide an 11 x 17 fold-out drawing of each floor plan and indicate locations of system shutoff valves.
   10. All pipe and equipment pressure test reports complete with 11 x 17 fold-out drawing, indicating all systems tested.
   11. Final Test and Balance (TAB) Reports. Do not include reports that have not been accepted by the A/E. Pencil or partial copies will not be acceptable.
   12. Maintenance procedures for each item of mechanical equipment to include frequency and type of maintenance, spare parts and attic/stock list. This shall include the manufacturer's literature indicating operating and maintenance instructions, parts list, illustrations and diagrams.
   13. Valve tag chart
   14. Mechanical systems functional performance verification forms, calibration reports and compliance statement indicating that all systems are installed and functioning per the contract requirements.

C. The O & M Manuals shall be submitted to the A/E for review of general conformance.

3.7 DEMONSTRATION AND TRAINING

A. Upon completion of work, instruct the owner's representative in the proper operation and maintenance of each mechanical system in accordance with applicable specification sections.

B. Instructions shall be given by persons expert in the operation and maintenance of each system / equipment.

C. Prepare statement(s) for signing by Owner's representative indicating the date of completion of instructions and hours expended. Furnish copies of signed statements to the A/E.

D. Final demonstration of all mechanical equipment shall be recorded in DVD compatible format. Provide DVDs to the Owner.

3.8 RECORD DOCUMENTS

A. The Contractor shall maintain a record set of plumbing prints at the project site and shall indicate thereon any changes made to the contract drawings, including, but not limited to addenda, field sketches, RFI responses, supplemental drawings, sketches, etc. Where changes are made that are reflective of supplemental instructions, revisions, RFI responses, etc., the Contractor shall make clear references to those changes.

B. A separate set of neat, legible mechanical contract prints shall be kept at the project site at all times during the construction of the work for the express purpose of showing any and all changes indicated in paragraph A. above. The prints shall be marked up daily showing all changes to the original documents. The prints shall be marked up in a neat, legible manner using a red pen. Periodic review of the Record Documents will be conducted by the Owner's Representative or A/E. Should this review indicate that the Record Documents are deficient or not up to date, the Contractor shall immediately bring the documents into compliance and make the corrections

C. Upon completion of the project and before final close-out, the Contractor shall be responsible for producing a final set of record documents in electronic CADD format. One (1) set of full size prints, one (1) CD of the electronic CADD drawings (in AutoCad and pdf format), along with the red-lined marked up field set shall be delivered to the owner upon completion. If requested, the electronic CADD documents shall be up-loaded to the owner's FTP site. The final CADD documents shall indicate in the title or revision block "RECORD DOCUMENTS" along with the date completed. The electronic format shall be compatible with the owner's preferred version of AutoCad. Coordinate with the owner before producing the CD or up-loading to the FTP site. Not acceptable are contractor installation drawings, shop drawings or multi-layers of work on a single drawing. The final as-built product shall mirror the contract bid documents using the project page layout, format and project title block.

D. Computer (CADD) files of plumbing drawings will be made available to the Contractor upon receipt of a signed waiver (available upon request). One CD will be made available to the general contractor or construction manager for distribution to the trades.

E. Should the Contractor's electronic Record Documents not be considered complete, they will be returned for completion and/or correction.

3.9 CLOSEOUT DOCUMENTS

A. Prior to Substantial Completion and /or Final Payment, the Contractor shall prepare and submit the following:
   1. Final punch lists indicating completion of all items
   2. All record drawings
   3. All record specifications

4. Operation and Maintenance Manuals
5. Complete final cleaning
6. Remove temporary facilities and complete site restoration

END OF SECTION

SECTION 22 0500 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this Section.
B. Requirements specified in all Division-22 sections apply to this Section.

1.2 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:
   1. Mechanical equipment nameplate data.
   2. Firestopping: Provide seals for all openings through fire-rated walls, floors, or ceilings used as passage for mechanical and electrical components such as piping, conduit, etc.
   3. Selective demolition including:
      a. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
      b. Dismantling mechanical materials and equipment made obsolete by these installations.
   4. Excavation for underground utilities and services, including underground piping (under the building and from building to utility connection), tanks, basins, and equipment up to five (5) feet (1500 mm) outside the building.
   5. Miscellaneous metals for support of mechanical materials and equipment.
   6. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
   7. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
   8. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.

1.3 DEFINITIONS

A. The following definitions apply to excavation operations:
   1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are

encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.

2. Subbase: As used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
3. Subgrade: As used in this Section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

B. The following definitions apply to firestopping:
1. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.
2. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.
3. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gases and smoke.
4. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
5. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, at wall tops between top of wall and ceiling, and structural floors or roof decks; and gaps between adjacent sections of structural floors.
6. System: Specific products and applications classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.
7. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division-01 Specification Sections.

B. Product data for the following products:
1. Access panels and doors
2. Joint sealers

C. Firestopping: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures.
1. Provide details of each proposed assembly identifying intended products and applicable UL system number, or UL classified devices.
2. Provide drawings relating to non-standard applications as needed.

D. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.
E. Coordination drawings for access panel and door locations in accordance with Division-22 sections.
F. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.
G. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
H. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
    1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division-01 Section "Summary of Work."

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an Installer for the installation and application of joint sealers, access panels and doors, and firestopping materials with at least two years' experience with installations.
B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
C. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
D. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
    1. Provide UL Label on each fire-rated access door.
E. Local and State Regulatory Requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL firestop system numbers, or UL classified devices.
F. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.7 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   2. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Conditions Affecting Excavations: The following project conditions apply:
   1. Maintain and protect existing building services which transit the area affected by selective demolition.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
   3. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
   4. Existing Utilities: Locate existing underground utilities in excavation areas prior to excavation. If utilities are indicated to remain, support and protect services during excavation operations.
   5. Remove existing underground utilities indicated to be removed.
   6. Uncharted or Incorrectly Charted Utilities: Contact utility owner immediately for instructions.
   7. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to Architect prior to utility interruption.
   8. Use of explosives is not permitted.

C. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

1.8 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.

B. Notify the Architect at least five (5) days prior to commencing demolition operations.
C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS

2.1 MECHANICAL EQUIPMENT NAMEPLATE DATA
A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.2 FIRESTOPPING
A. All penetrations through fire barriers shall be firestopped with an approved material that is capable of maintaining the fire resistance rating of the barrier. All firestop sealants shall conform to ASTM E 814, ASTM E 119, UL 1479, UL 2079 CAN/ULC S115, and CAN/ULC S101.
B. Firestop material shall be latex based, intumescent caulk intended for use for all thru-penetrations with piping, cable trays, conduit, and cables.
C. When exposed to high temperatures or fires, the caulk shall expand in volume to quickly close off voids left by melting or burning construction materials. Caulk shall be applied by a standard caulk gun and remain flexible after curing.
D. Acceptable products shall be limited to Johns Manville "Firetemp-C1;" Hilti "FS-One;" or 3M "CP25WB+." Coordinate with General Contractor such that a single manufacturer/product is utilized throughout the project for all fire and smoke stopping materials.

2.3 SMOKE STOPPING
A. All penetrations through smoke barriers, smoke partitions, or any other surface required to resist the passage of smoke shall be provided with a smoke stop sealant and/or system that has been independently tested to provide an acceptable smoke seal that will resist the passage of smoke. Smoke stop systems (including product and installation) shall conform to all applicable standards (including but not limited to ASTM, UL and NFPA), as well as all other local, state or federal requirements.
B. Acceptable manufacturers shall be limited to the manufacturers that may provide firestopping materials/systems (see paragraph 2.02 of this section). Coordinate with the General Contractor such that a single manufacturer/product is utilized throughout the project for all fire and smoke stopping materials.

2.4 SOIL MATERIALS

A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch (40 mm) sieve, and not more than 5 percent passing a No. 4 sieve.

C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches (150 mm) in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

2.5 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout, recommended for interior and exterior applications.

F. Fasteners: Zinc-coated, type, grade, and class as required.

2.6 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches (12 mm).

2.7 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with

fungicide; intended for sealing interior joints with non-porous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.

D. Acrylic-Emulsion Sealants: One-part, non-sag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes through fire rated walls and floors. Sealants and accessories shall have fire resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.8 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage (1.6 mm) steel, with a 1-inch (25 mm) wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
   1. For Installation in Masonry, Concrete, Ceramic Tile, or Wood Paneling: 1-inch (25 mm) wide exposed perimeter flange and adjustable metal masonry anchors.
   2. For Gypsum Wallboard or Plaster: Perforated flanges with wallboard bead.
   3. For Full-Bed Plaster Applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

C. Flush Panel Doors: 14-gage (2 mm) sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees (3.05 Radians); factory-applied prime paint.
   1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

D. Locking Devices: Flush, screwdriver-operated cam locks. [Common use]

E. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide two (2) keys. [Secured areas only: note as such].

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 installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FIRESTOP INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.
B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.
C. Where floor openings without penetrating items are more than four inches (100 mm) in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.
D. Protect materials from damage on surface subject to traffic.
E. Place firestopping in annular space around fire dampers before installation of damper's anchoring flanges which are installed in accordance with fire damper manufacturer's recommendations.
F. Where large openings are created in walls or floors to permit installation of pipes, cable tray, bus duct or other items, close unused portions of opening with firestopping material tested for the application.
G. Install smoke stopping as specified for firestopping.
H. Where rated walls are constructed with horizontally continuous air space, double width masonry, or double stud frame construction, provide vertical, 12 inch (300 mm) wide fiber dams for full thickness and height of air cavity at maximum 15 foot (4500 mm) intervals.

3.3 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.4 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved.
B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Mechanical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
   1. Inactive and obsolete piping, fittings and specialties, equipment, controls, fixtures, and insulation.
   2. Piping and ducts embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings. Drain and cap piping and ducts that are allowed to remain.
   3. Perform cutting and patching required for demolition in accordance with Division-01 Section "Cutting and Patching."

3.5 EXCAVATION

A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
   1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches (750 mm) below finished grade elevation.

C. Install sediment and erosion control measures in accordance with local codes and ordinances.

D. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
   1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

E. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

F. Excavation for Underground Tanks, Basins, and Mechanical Structures: Conform to elevations and dimensions shown within a tolerance of plus

or minus 0.10 foot (30 mm); plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. Excavate by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch (25 mm) in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

G. Trenching: Excavate trenches for mechanical installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches (150 to 225 mm) clearance on both sides of pipe and equipment.
2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches (150 mm) of stone or gravel cushion between rock bearing surface and pipe.
5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
6. For pipes or equipment 6 inches (150 mm) or larger in nominal size, shape bottom of trench to fit bottom 1/4 of the circumference. Fill unevenness with tamped sand backfill. At each pipe joint over-excavate to relieve the bell or pipe joint of the pipe of loads, and to ensure continuous bearing of the pipe barrel on the bearing surface.

H. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F (2 degrees C).

I. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For piping less than 30 inches (750 mm) below surface of roadways, provide 4-inch (100 mm) thick concrete base slab support. After installation and testing of piping, provide a 4-inch (100 mm) thick concrete encasement (sides and top) prior to backfilling and

placement of roadway subbase.

5. In other areas, use excavated or borrowed materials.

J. Backfill excavations as promptly as work permits, but not until completion of the following:
   1. Inspection, testing, approval, and locations of underground utilities have been recorded.
   2. Removal of concrete formwork.
   3. Removal of shoring and bracing, and backfilling of voids.
   4. Removal of trash and debris.

K. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches (200 mm) in loose depth for material compacted by heavy equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

L. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

M. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them approximately to same elevation in each lift.

N. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
   1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
   2. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches (300 mm) of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
   3. Areas Under Walkways: Compact top 6 inches (150 mm) of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
   4. Other Areas: Compact top 6 inches (150 mm) of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
   5. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water.

Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

O. Subsidence: Where subsidence occurs at mechanical installation excavations during the period twelve (12) months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
   1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
   2. Comply with recommendations of ASTM C 790 for use of acrylic - emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.9 INSTALLATION OF ACCESS DOORS

A. Provide access doors (minimum 18" x 18") as required to provide

maintainable access to all mechanical equipment including, but not limited to, valves, etc.

B. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

END OF SECTION

SECTION 22 0510 - PLUMBING RELATED WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of mechanical related work required by this section is indicated on drawings and/or specified in other Division-22 sections.

B. Types of mechanical related work specified in this section include the following:

1. Access to Mechanical Work:

a. Access doors in floors.

b. Removable cover plates in floors.

2. Excavating for Mechanical Work:

a. Underground mechanical utilities and services.

b. Underground tanks, basins, and equipment enclosures.

c. Exterior water circulation and distribution systems.

d. Drainage and distribution fields.

3. Concrete for Mechanical Work:

a. Lean concrete backfill to support mechanical work.

b. Encasement of mechanical work.

c. Underground structural concrete to accommodate mechanical work.

d. Tanks and vaults of mechanical work.

e. Basins and curbs for mechanical equipment.

f. Mechanical equipment foundations and housekeeping pads.

g. Inertia bases for isolation of mechanical work.

h. Rough grouting in and around mechanical work.

i. Patching concrete cut to accommodate mechanical work.

4. Painting of Mechanical Work:

a. Exposed concrete provided as part of mechanical work.

b. Exposed piping systems.

c. Exposed mechanical insulation.

d. Exposed mechanical equipment.

e. Louvers.

f. Color-coded work.

C. Access door requirements associated with mechanical work and mechanically related electrical components are specified in this section.

D. Quality control testing for concrete work is required as work of this section.

1.2 QUALITY ASSURANCE

A. Access Units Fire-Resistance Ratings: Where fire-resistance rating is indicated for construction penetrated by access units, provide UL listed-and-labeled Class B units, except for units which are smaller than minimum size requiring ratings as recognized by governing authority.

B. Concrete Work Codes and Standards: Comply with governing regulations and, where not otherwise indicated, comply with the following industry standards, whichever is the most stringent in its application to work in each instance:

1. ACI 301 "Specifications for Structural Concrete for Buildings".

2. ACI 311 "Recommended Practice for Concrete Inspection".

3. ACI 318 "Building Code Requirements for Reinforced Concrete".

4. ACI 347 "Recommended Practice for Concrete Formwork".

5. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".

6. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

C. Federal Specifications, Painting Work: In general and where applicable, comply with indicated Federal Specifications for paint quality, and use only paint from original containers which bear manufacturer's labels indicating compliance with required Federal Specifications.

1.3 SUBMITTALS

A. Product Data, Access Units: Submit manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.

B. Shop Drawings, Mechanical Concrete Work: Submit shop drawings for structural type concrete work (tanks, vaults, basins, foundations and other supports), showing dimensions of formed shapes of concrete; bending, placement, sizes and spacing of reinforcing steel; location of anchors, isolation units, hangers and similar devices to be integrated with concrete work; and piping penetrations, access openings, inlets and other accessories and work to be accommodated by concrete work.

C. Manufacturer's Data, Mechanical Concrete Work: Submit data on products, including cements, special aggregates, form-coating compound, admixtures, moisture barriers, waterstops, expansion joint fillers, sealants, and concrete curing products. Provide manufacturer's certification where indicated.

D. Laboratory Test Reports, Mechanical Concrete Work: Submit laboratory test reports for concrete work materials, and for tested samples of placed concrete (where required as work of this section).

E. Mixing Tickets, Mechanical Concrete Work: Submit ticket for each batch of mixed concrete used in work, indicating project identification, location where placed, date, mixing time, mix type, amount of water introduced, amount of concrete placed, and other significant or unusual data.

F. Manufacturer's Data, Paint for Mechanical Work: Submit manufacturer's technical information, including analysis of ingredients and application instructions for products used in painting work.

G. Samples, Paint for Mechanical Work: Submit 12" x 12" (300 mm x 300 mm) color samples of each required finish paint color (except black and white); prepared on 1/8" (3 mm) tempered hardboard, on smooth face where application is for smooth surfaces and on texture face for textured surface applications. Use actual paint materials to be applied, and label

each sample to show materials and coats applied.

1.4 PROJECT CONDITIONS

A. Existing Utilities: Locate and protect existing utilities and other underground work in manner which will ensure that no damage or service interruption will result from excavating and backfilling.

B. Protect property from damage which might result from excavating and backfilling.

C. Protect persons from injury at excavations, by barricades, warnings and illumination.

D. Coordinate excavations with weather conditions, to minimize possibility of washouts, settlements and other damages and hazards.

E. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install mechanical work on frozen excavation bases or subbases.

F. Environmental Conditions, Painting Work: Comply with governing regulations concerning use of and conditions for application of paint. Comply with manufacturer's recommendations and instructions. Do not apply paint in unfavorable conditions of temperature, moisture (including humidity) or ambient contamination (dust and other pollutants).

PART 2 - PRODUCTS

2.1 ACCESS TO MECHANICAL WORK

A. Access Doors - General: Where floors must be penetrated for access to mechanical work, provide types of access doors indicated, including floor doors if any. Furnish sizes indicated or, where not otherwise indicated, furnish adequate size for intended and necessary access. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.

B. Floor Door Construction: Except as otherwise indicated, fabricated floor door shall be of welded steel construction, reinforced for 300 lbs. per sq. ft. (14.4 kPa) loading, with exposed welds ground smooth; 1/4" (6 mm)

thick steel angle or formed steel frames, and 1/4" (6 mm) steel raised-pattern floor plate; steel strap anchors for casting in concrete; 90-degree brass/bronze hinges with stainless steel pins, and spring-type operators with hold-open arms; snap-type inside latch with removable handle, and, where applicable, inside lever latch handle and door operating handle; factory-applied rust-inhibitive prime-coat paint finish.

1. Gasketed Construction: Where indicated as "Sealed", furnish manufacturer's gasketed-type door, with built-in protected cushion-type neoprene gasket, intended for reduction of noise, air and moisture penetration.

2. Drained Construction: Where indicated as "Drained", or where drainage pipe connection is shown, furnish manufacturer's gutter-type or watertight-type unit, complete with drainage slots or ports at floor surface, and with gutter all around with one or more drain pipe connections.

3. Double-Leaf Construction: Where opening width exceeds 3'- 0" (900 mm - 0 mm), furnish manufacturer's standard double-leaf unit construction.

4. Recessed Floor-Finish Construction: Where floor doors occur in areas of floor finish other than concrete or coated-concrete, furnish manufacturer's standard recessed-panel type construction of type and recess depth recommended to receive insets of floor finish indicated.

C. Removable Access Plates:

1. General: Where valves, control devices, cleanouts and similar elements of mechanical work are located within or behind wall, ceiling or floor construction or finishes, or below grade, and are not (cannot be), provided with integral removable access plates as specified in other Division-22 sections, provide removable access plates of types and sizes needed for access requirements, as indicated. Provide manufacturer's complete unit with anchorages, fasteners and standard factory-applied finishes.

2. Wall/Ceiling Unit Construction: Except as otherwise indicated, and where adaptable to substrate, provide manufacturer's standard frameless round formed stainless steel or chrome-plated brass low profile plate cover, with single exposed flush screw anchor, with bright polished finish.

3. Painted Finish: Where substrate is indicated for painted finish, provide steel units with prime-coat paint finish.

4. Floor Unit Construction: Except as otherwise indicated, provide manufacturer's standard round cast-iron units, with frame or body designed for casting flush in concrete; with removable plate secured with bronze screws, and surfaced with non-slip cast pattern; natural mill finish.

    a. Sleeve-Type: Where required floor opening or hand hole extends through thickness of cast floor slab, provide unit body of same depth as slab thickness, to act as form for casting opening.

    b. Square Units: Where square units are indicated, provide manufacturer's modular units of size which integrate as closely as possible with finish flooring unit sizes (if any).

    c. Recessed Units: Where finish of floor is other than concrete, provide recessed-panel type construction, of type and recess depth recommended to receive insets of floor finish indicated.

    d. Finish: Provide recessed units with exposed metal (exposed after inset has been installed) of nickel bronze, manufacturer's standard finish. Provide matching fasteners.

5. Units Set at Grade: Except as otherwise indicated, provide manufacturer's standard round or square cast-iron units, complete cast-iron pipe extension to protect mechanical element being accessed; designed to be set slightly above finish grade, and to be either supported by compacted soil or to be encased in concrete; secure plate to body with bronze screws; natural mill finish on plate and body.

2.2 EXCAVATING FOR MECHANICAL WORK

A. Subbase Material: Provide graded mixture of gravel, sand, crushed stone or crushed slag.

    1. Finely-Graded Subbase Material: Well graded sand, gravel, crushed stone or crushed slag, with 100% passing 3/8" (10 mm) sieve.

B. Backfill Material: Soil material suitable for compacting to required densities, and complying with AASHO Designation M145, Group A-1, A-2-4, A-2-5 or A-3.

C. Drainage Fill Material: Washed and uniformly graded gravel, crushed stone or crushed slag, with 100% passing 1-1/2" (40 mm) sieve and not more than 5% passing No. 4 sieve.

2.3 MATERIALS OF CONCRETE WORK

A. Forms for Exposed Concrete: Plywood, smooth metal or other smooth panel type material; sized for minimum joint exposure, and reinforced to prevent visible deflections resulting from pressure of placed concrete; sufficiently heavy for construction to prevent leakage which would be harmful to either structural or visual quality of concrete.

1. Plywood "BB (Concrete Form) Plywood", Class I, Exterior Grade, mill-oiled and edge sealed.

B. Forms for Unexposed Concrete: Smooth lumber, plywood or other easy-release material; reinforced to prevent excessive deflection or the possibility of failure during placement of concrete; sufficiently heavy for construction to prevent leakage which would be harmful to structural quality of concrete.

C. Form Ties: For exposed concrete surfaces, provide snap-off type ties designed to snap off 1-1/2" (40 mm) below surface.

D. Exposed-Corner Chamfer Strips: Provide wood, metal, plastic or rubber chamfer strips in forms at exposed external corners of concrete work.

E. Form-Coating Compound: Commercially formulated compound which will prevent bond of concrete to forms. Provide compound recommended by manufacturer for application indicated, and which will not stain concrete or interfere with moisture curing of concrete or subsequent painting of exposed surfaces.

F. Reinforcing Materials:

1. Reinforcing Bars: Except as otherwise indicated, provide ANSI/ASTM A 615, deformed, Grade 40 for size numbers 3 through 18; ANSI/ASTM A 675, plain, Grade 60, for size number 2; sizes as shown.

2. Steel Wire: ANSI/ASTM A 82, plain, cold-drawn.

3. Welded Wire Fabric: ANSI/ASTM A 185; sizes and spacings of wires as shown; 6" x 6" (150 mm x 150 mm) x No. 10 x No. 10 where not otherwise indicated.

4. Reinforcement Supports: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Provide wire bar type supports complying with CRSI

recommendations, unless otherwise indicated.

a. For on-grade work, provide supports with sand plates or horizontal runners.

b. At exposed surfaces, provide supports with legs that are stainless steel protected (CRSI, Class 2), or plastic protected (CRSI, Class 1).

G. Concrete Materials:

1. Portland Cement: ANSI/ASTM C 150, Type I, except as otherwise indicated.

2. Aggregates: ANSI/ASTM C 33, except as otherwise indicated.

a. Local aggregates not complying with ANSI/ASTM C 33, but which shown by special test or actual service to produce concrete of adequate strength and durability may be used.

b. For rough grouting, provide aggregate which is well graded and 100 percent passing through 3/8" (10 mm) sieve.

3. Water: Clean and free of substances harmful to concrete.

4. Air-Entraining Admixture: ANSI/ASTM C 260.

5. Water-Reducing Admixture: ANSI/ASTM C 494, Type A (normal range) and Type F (high-range, super plasticizer).

6. Set-Control Admixtures: ANSI/ASTM C 494, as follows:

a. Type B, Retarding.

b. Type C, Accelerating.

c. Type D, Water-reducing and Retarding.

d. Type E, Water-reducing and Accelerating.

e. Type G, High-Range Water-Reducing and Retarding (Super-plasticizer).

7. Calcium Chloride: Use not permitted.

2.4 DESIGN AND PROPORTIONING OF MIXES

A. General: Design mechanical work concrete as follows, for each 28-day compressive strength class:

1. 4000 psi (27580 kPa) Class: 565 lbs. of cement per cu. yd. (335 kg/m3) (6.0 sacks), and 0.35 water/cement ratio.

2. 3000 psi (20685 kPa) Class: 500 lbs. of cement per cu. yd. (296 kg/m3) (5.25 sacks), 0.46 water/cement ratio.

3. 2500 psi (17238 kPa) Class: 450 lbs. of cement per cu. yd.(268 kg/m3) (4.75 sacks), and 0.54 water/cement ratio.

4. Backfill Class (Lean Concrete): 375 lbs. of cement per cu. yd., (223 kg/m3) (4.0 sacks), and 0.60 water/cement ratio.

5. Rough Grouting Class: 565 lbs. of cement per cu. yd. (335 kg/m3) (6.0 sacks), and 0.60 water/cement ratio.

B. Admixtures: Except as otherwise indicated, use is at Contractor's option. Comply in each instance with admixture manufacturer's recommendations and suggested limitations for required quality of concrete. Use water-reducing admixture (normal or high-range in all concrete).

C. Air Entrainment: Comply with the following limitations for resulting air entrainment:

1. Concrete Above Grade: Not less than 2%, nor more than 4%.

2. Concrete Below Grade: Not less than 2% nor more than 4%, except up to 6% where maximum aggregate size must be 3/4" (20 mm) or less.

3. Rough Grout Concrete: Not less than 4%, nor more than 8%.

4. Backfill Concrete: Not more than 7%.

D. Slump Limitations: Limit water content in design mixes to produce the following slumps at point of placement (but do not exceed specified water/cement ratios). Concrete containing high-range water-reducing admixture may have slump limit up to 8" (200 mm).

1. Reinforced Structural Concrete: For concrete which is reinforced (with more than shrinkage crack protection), or in strength class of 3000 psi (20685 kPa) and above, limit slump to range of 1" to 3" (25

mm to 75 mm).

2. Plain Concrete: For concrete which is not reinforced or reinforced only for shrinkage crack protection, and in strength class below 3000 psi (20685 kPa), limit slump to range of 2" to 5" (50 mm to 125 mm).

3. Rough Grout Concrete: Limit slump to range of 3" to 7" (75 mm to 175 mm).

4. Backfill Concrete: Limit slump to 5" (125 mm).

E. Mix for Patching: Where mechanical work requires patching of exposed concrete work which has been cut to accommodate mechanical work, provide concrete patching mix which is identical with mix of work being patched (same cement, aggregates, admixtures and proportioning).

2.5 CONCRETE MIXING

A. Job-Site Mixing: Mix materials for concrete in drum-type batch machine mixer. For mixers of 1.0 cu. yd. (.84 m2), or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after all ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than 1.0 cu. yd. (.84 m2), increase mixing time by 15 seconds for each additional cu. yd., or fraction thereof.

1. Prepare and submit batch ticket for each batch discharged and used in work.

B. Ready-Mix Concrete: Comply with requirements of ANSI/ASTM C 94, except as otherwise indicated.

1. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to batch will not be permitted.

2. During hot weather, or under conditions contributing to rapid setting of concrete, mix each load for shorter period of time than specified in ANSI/ASTM C 94. When air temperature is between 85 and 90 degrees F (29.4 and 32.2 degrees C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F (32.2 degrees C), reduce mixing and delivery time to 60 minutes.

2.6 GENERAL PAINTING PRODUCT REQUIREMENTS

A. Pigments: Provide paint with pure, non-fading pigments, recognized to be safe, durable and environmentally acceptable, and containing not more than 0.5 percent lead (by weight in total dry film).

B. Vehicles and Thinners: Comply with governing regulations and recognized safe practices in handling, use and drying of paint vehicles and thinners. Compatibility of paint products is the Contractor's exclusive responsibility. Select paint products to ensure freedom from problems relating to vehicles and thinners of type and within limits recommended by paint manufacturer.

C. Undercoat Paints: Use paint produced by same manufacturer as paint to be used for finish coats.

D. Colors: Provide colors as indicated or established by the Owner by color schedule or by other indication or, where not otherwise indicated, as selected by the Owner from manufacturer's standard (non-premium cost) colors available for type of paint to be provided in each case.

E. Color-Coded Finishes: For finishes indicated to be color-coded for identification, provide paint complying with the color requirements of ANSI A13.1 "Scheme for the Identification of Piping Systems", except where another specific color requirement is indicated.

F. "Paint": As used herein means coating system materials, including primers, emulsions, enamels, sealers, fillers and other applied materials whether used as prime, intermediate or finish coats.

G. Standards: In the following designated paint systems (example: "IPS-22") the descriptions similar to "... (TT-P-55, Type II)..." refer to Federal Specifications of that number, and indicate required compliance with that publication as minimum standard of quality for paint product as named. Product of recognized higher quality can be used, provided either label indicates compliance with required standard, or manufacturer submits proof and certification that product meets or exceeds standard in every significant measure of quality.

H. Optional Systems: Where more than one paint system is designed for particular substrate, selection is Contractor's option except where distinct paint system is shown or scheduled for particular portion or area of that substrate.

2.7 EXTERIOR PAINT SYSTEMS

A. Concrete:

1. EPS-I: 1st Coat - Acrylic emulsion (TT-P-19).

   2nd Coat - Acrylic emulsion (TT-P-19).

   Not less than 2.5 mils dry-film thickness.

2. EPS-2: 1st Coat - Vinyl acrylic emulsion (TT-P-55, Type II).

   2nd Coat - Vinyl acrylic emulsion (TT-P-55, Type II).

3. EPS-3: 1st Coat: Heavy-duty, textured coating (TT-C-555, Type II).

   Not less than 15.0 mils dry-film thickness.

B. Cement:

1. EPS-6: 1st Coat - Primer undercoat (TT-P-25).

   2nd Coat - Acrylic emulsion (TT-P-19).

   3rd Coat - Acrylic emulsion (TT-P-19).

   Not less than 3.5 mils dry-film thickness.

C. Ferrous Metal:

1. EPS-15: 1st Coat - Zinc-yellow iron oxide primer (TT-P-57, Type II).

2. EPS-15: 1st Coat - Red lead pigmented primer (TT-P-86, Type III).

   2nd Coat - High-gloss alkyd enamel (TT-E-489, Class A).

   3rd Coat - High-gloss alkyd enamel (TT-E-489, Class A).

   First coat not required on items delivered shop primed.

3. EPS-16: 1st Coat - Zinc-yellow iron oxide primer (TT-P-57, Type II).

4. EPS-16: 1st Coat - Red lead pigmented primer (TT-P-86, Type III).

2nd Coat - Semi-gloss alkyd enamel (TT-E-529, Class A).

3rd Coat - Semi-gloss alkyd enamel (TT-E-529, Class A).

First coat not required on items delivered shop primed.

5. EPS-17: 1st Coat - Zinc-yellow iron oxide primer (TT-P-57, Type II).

6. EPS-17: 1st Coat - Red lead pigmented primer (TT-P-86, Type III).

2nd Coat - Lusterless alkyd enamel (TT-E-527).

3rd Coat - Lusterless alkyd enamel (TT-E-527).

First coat not required on items delivered shop primed.

7. EPS-18: 1st Coat - Zinc-yellow iron oxide primer (TT-P-57, Type II).

2nd Coat - Alkyd gloss enamel (TT-E-37).

3rd Coat - Alkyd gloss enamel (TT-E-37).

First coat not required on items delivered shop primed.

8. EPS-19: 1st Coat - Basic lead silico chromate primer (TT-P-615, Type III).

9. EPS-19: 1st Coat - Zinc chromate alkyd primer (TT-P-645).

2nd Coat - Semi-gloss silicone alkyd enamel (TT-E-490).

3rd Coat - Semi-gloss silicone alkyd enamel (TT-E-490).

D. Zinc-Coated Metal:

1. EPS-20: 1st Coat - Zinc dust-zinc oxide primer (TT-P-641).

2nd Coat - High gloss alkyd enamel (TT-E-489, Class A).

3rd Coat - High gloss alkyd enamel (TT-E-489, Class A).

E. Aluminum:

1. EPS-21: 1st Coat - Zinc chromate primer (TT-P-645).

2nd Coat - High gloss alkyd enamel (TT-E-489, Class A).

3rd Coat - High gloss alkyd enamel (TT-E-489, Class A).

2.8 INTERIOR PAINT SYSTEMS

A. Concrete:

1. IPS-1: 1st Coat - Interior latex emulsion (TT-P-29).
   2nd Coat - Interior latex emulsion (TT-P-29).
   2nd Coat - Interior alkyd emulsion, odorless (TT-P-30).
2. IPS-2: 1st Coat - Interior latex emulsion (TT-P-29).
   2nd Coat - Interior enamel undercoat (TT-E-543).
   3rd Coat - Interior enamel, semi-gloss (TT-E-509).
   Not less than 3.5 mils total dry-film thickness.
3. IPS-3: 1st Coat - Acrylic emulsion (TT-P-19).
   2nd Coat - Acrylic emulsion (TT-P-19).
4. IPS-4: 1st Coat - Interior latex emulsion (TT-P-29).
   2nd Coat - Polyester epoxy (TT-C-5451.
   3rd Coat - Polyester epoxy (TT-C-545).
   Not less than 4.0 mils dry-film thickness

B. Cement:

1. IPS-9: 1st Coat - Interior latex emulsion (TT-P-29).
   2nd Coat - Interior latex emulsion (TT-P-29).

C. Ferrous Metal:

1. IPS-19: 1st Coat - Red lead primer (TT-P-86).
   2nd Coat - Interior latex emulsion (TT-P-29).
   3rd Coat - Interior latex emulsion (TT-P-29).
   First coat not required on items that are shop primed.

Not less than 2.5 mils dry-film thickness.

2. IPS-20: 1st Coat - Red lead primer (TT-P-86).

   2nd Coat - Enamel undercoat (TT-E-543).

   3rd Coat - Semi-gloss enamel (TT-E-509).

   First coat not required on items that are shop primed.

   Not less than 2.5 mils dry-film thickness.

3. IPS-21: 1st Coat - Red lead primer (TT-P-86).

   2nd Coat - Enamel undercoat (TT-E-543).

   3rd Coat - Gloss enamel (TT-E-506).

   First coat not required on items that are shop primed.

   Not less than 2.5 mils dry-film thickness.

D. Zinc-Coated Metal:

1. IPS-22: 1st Coat - Zinc dust-zinc oxide primer (TT-P-641).

   2nd Coat - Interior latex emulsion (TT-P-29).

   3rd Coat - Interior latex emulsion (TT-P-29).

   Not less than 2.5 mils dry-film thickness.

2. IPS-23: 1st Coat - Zinc dust-zinc oxide primer (TT-P-641).

   2nd Coat - Enamel undercoat (TT-E-543).

   3rd Coat - Semi-gloss enamel (TT-E-509).

   Not less than 2.5 mils dry-film thickness.

3. IPS-24: 1st Coat - Zinc dust-zinc oxide primer (TT-641).

   2nd Coat - Enamel undercoat (TT-E-543).

   3rd Coat - Gloss Enamel (TT-E-506).

   Not less than 2.5 mils dry-film thickness.

E. Fabric Covering on Insulation:

1. IPS-33: 1st (Size) Coat - Interior latex emulsion (TT-P-29).

   2nd Coat - Interior latex emulsion (TT-P-29).

   Add fungicidal agent to render fabric mildew-proof.

PART 3 - EXECUTION

3.1 ACCESS TO MECHANICAL WORK

A. Comply with manufacturer's instructions for installation of floor doors, and removable access plates.

B. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

D. Remove or replace panels or frames which are warped, bowed, or otherwise damaged.

3.2 EXCAVATING FOR MECHANICAL WORK

A. General: Do not excavate for mechanical work until work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimum.

B. Excavate with vertical sided excavations to greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger work or other property. Where not removed, cut sheeting off at sufficient distance below finished grade to not interfere with other work.

C. Width: Excavate for piping with 6" to 9" (150 mm to 225 mm) clearance on both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Excavate for other mechanical work to provide minimum practical but adequate working clearances.

D. Depth for Direct Support: For work to be supported directly on undisturbed soil, do not excavate beyond indicated depths, and hand-excavate bottom cut to accurate elevations. Except as otherwise indicated,

support the following work on undisturbed soil at bottom of the excavations:

1. Piping of 5" (125 mm) and less pipe/tube size.

2. Cast-in-place concrete.

E. Depth for Subbase Support: For large piping (6" pipe size and larger) (150 mm pipe size and larger) tanks, and where indicated for other mechanical work, excavate for installation of subbase material in depth indicated or, if not otherwise indicated, 6" (150 mm) below bottom of work to be supported.

F. Depth for Unsatisfactory Soil Conditions: Where directed (because of unsatisfactory soil condition at bottom of indicated excavation), excavate additional depth as directed to reach satisfactory soil bearing condition. Backfill with subbase material, compacted as directed, to indicated excavation depth.

G. Depth for Exterior Piping: Except as otherwise indicated, excavate for exterior water-bearing piping (water, steam condensate, drainage) so that top of piping will not be less than 2'- 6" (600 mm-150 mm) vertical distance below finished grade.

H. Excavate near large trees (within drip line) by hand, and protect root system from damage or dryout to greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" (25 mm) diameter and larger with asphaltic tree paint.

I. Store excavated material (temporarily) near excavation, in manner which will not interfere with or damage excavation or other work. Do not store under trees (within drip line).

1. Retain excavated material which complies with requirements for backfill material.

2. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material.

a. Move unused material to another location on Owner's property, at or adjacent to project site, and dispose of as directed by the Owner.

b. Remove unused material from project site, and dispose of in lawful manner.

3.3 DEWATERING

A. Maintain dry excavations for mechanical work, by removing water. Protect excavations from inflow of surface water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water, by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations and below-grade property from being damaged by water, sediment or erosion from or through mechanical work excavations.

1. Install and operate well-point dewatering system to maintain ground water at level approximately 2'- 0" (600 mm - 0 mm) below mechanical work excavations, until backfilling is completed.

3.4 BASE PREPARATION

A. Subbase Installation: Where indicated, install subbase material to receive mechanical work, and compact by tamping to form firm base for work. For piping, horizontal cylindrical tanks, and similar work, shape subbase to fit shape of bottom 90 degree of cylinder, for uniform continuous support.

1. Provide finely-graded subbase material for wrapped, coated, and plastic pipe and tanks.

B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanged connections, valves and similar enlargements in piping systems.

C. Concrete Encasement: Where piping under roadways is less than 2'- 6" (600 mm-150 mm) below surface of roadway, provide 4" (100 mm) base slab of concrete to support piping. After piping is installed and tested, provide 4" (100 mm) thick encasement (sides and top) of concrete before backfilling. Provide Class 2500 concrete for encasement and slab.

D. Previous Excavations: Where piping crosses over area more than 5'- 0" (1.5 m-0 mm) wide which has been previously excavated to greater depth than required for piping installation, provide suitable subsidence-proof support for piping. Comply with details shown or, where not otherwise shown, provide one of the following support systems:

1. Excavate to undisturbed soil, in width equal to pipe diameter plus 2'- 0" (600 mm-0 mm). Install 8" (200 mm) courses of subbase material, each compacted to 95% of maximum density, as required to fill excavation and support piping.

2. Excavate to undisturbed soil, in width equal to pipe diameter plus 1'-

0" (300 mm - 0 mm). Install lean concrete fill to required elevation for support of piping.

3.5 BACKFILLING

A. Do not backfill until installed mechanical work has been tested and accepted, wherever testing is indicated.

B. Install drainage fill where indicated, and tamp to uniform firm density.

C. Backfill with finely-graded subbase material to 6" (150 mm) above wrapped, coated, and plastic piping and tanks, and to centerline of other tanks.

D. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to required densities. Do not backfill with frozen soil materials.

E. Backfill simultaneously on opposite sides of mechanical work, and compact simultaneously; do not dislocate work from installed positions.

F. Backfill excavations in 8" (200 mm) high courses of backfill material, uniformly compacted to the following densities (% of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.

1. Lawn and Landscaped Areas: 85% for cohesive soils; 90% for cohesionless soils.

2. Paved Areas, Other Than Roadways: 90% for cohesive soils; 95% for cohesionless soils.

3. Roadways: 90% for cohesive soils; 95% for cohesionless soils.

G. Backfill to elevations matching adjacent grades, at time of backfilling excavations for mechanical work.

H. Compaction Tests: Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Owner. Allowable density tolerance is not more than one-test-out-of-5 falling more than 2 percentage points below specified density.

3.6 PERFORMANCE AND MAINTENANCE, EXCAVATION WORK

A. Subsidence: Where subsidence is measurable or observable at

mechanical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.7 INSTALLATION OF CONCRETE WORK

A. Formwork:

1. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be required size and shape and in required location. Construct with joints which will not leak cement paste. Form sides and bottoms of concrete work, except where clearly indicated to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.

    a. Install chamber strips at external corners of exposed concrete work.

    b. Construct forms to retain equipment anchor bolts in accurate locations during placement of reinforcing steel and concrete. Use templates, if available by equipment manufacturers, to locate anchor bolts or, where not furnished, locate by accurate measure from certified setting diagrams.

2. Form Coating: Coat concrete-contact surfaces of forms to be removed. Apply form-coating compound before reinforcement is placed. Apply in accordance with manufacturer's instructions and remove excess compound and spillage.

3. Cleaning and Tightening: Clean forms and adjacent surfaces to receive concrete just before concrete is placed. Retighten forms promptly during concrete placement where required to eliminate leakage of cement paste.

B. Placing Reinforcement:

1. General: Comply with requirements and recommendations of specified standards, including "Placing Reinforcing Bars" by CRSI. Place bars where indicated and support to prevent displacement during concrete placement, using appropriate reinforcement supports, properly spaced and wire tied to reinforcing bars.

a. Place reinforcement to obtain at least minimum recommended coverage for concrete protection. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

b. Install welded wire fabric in as long lengths as practicable. Laps adjoining pieces at least one full mesh and lace splices with 16-gage (1.6 mm) wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

c. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which would reduce bond with concrete.

C. Placing Concrete:

1. Wet wooden forms which have been coated with compound, immediately before concrete, and remove excess water from forms.

2. Strength-Class Applications: Comply with compressive-strength - classes shown on drawings for each unit of mechanical concrete work or, if not shown, comply with the following general application requirements.

a. Backfill: Provide backfill class (lean concrete).

b. Plain Concrete Encasement: Provide 2500 psi (17238 kPa) class.

c. Reinforced Concrete Encasement: Provide 3000 psi (20685 kPa) class.

d. Underground Structural Concrete: Provide 3000 psi (20685 kPa) class.

e. Tanks and Vaults: Provide 4000 psi (27580 kPa) class.

f. Block-Type Foundations: Where least dimension is not less than 0.2 x largest dimension, provide 3000 psi (20685 kPa) class.

g. Beam-Type Foundations: Where least dimension is less than 0.2 x largest dimension, provide 4000 psi (27580 kPa) class.

h. Miscellaneous Supported Work: Provide 3000 psi (206850 kPa) class for curbs, pads, inertia blocks and similar supported work.

i. Concrete Fill: Provide 2500 psi (17238 kPa) class for filling structural steel foundation frames and for filling similar large-volume units.

j. Concrete Grout: Provide rough grouting class for filling voids to be grouted which are too small to be filled effectively with 2500 psi (17238 kPa) class concrete.

k. Patching General Concrete Work: Match concrete being patched.

3. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.

4. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.

5. Bring horizontal surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps and hollows.

6. Cold Weather Placement: Comply with ACI 306. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. When air temperature has fallen or is expected to fall below 40 degrees F (4.4 degrees C), heat water and aggregates uniformly before mixing, as required to obtain concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F (26.7 degrees C), at time of placement. Protect concrete work from physical damage and reduced strength resulting from frost, freezing actions, or low temperatures.

7. Hot Weather Placement: Comply with ACI 305 when hot weather conditions could impair work.

   a. Maintain concrete temperature below 90 degrees F (32.2 degrees C) at time of placement, by cooling ingredients. Mixing water may be chilled, or chopped ice may be used to control concrete temperature, provided water equivalent of ice is included in calculating compliance with water/cement ratio limitations. Cover reinforcing steel with water-soaked burlap as necessary to ensure that steel temperature will not exceed ambient air temperature immediately before embedment in concrete.

8. Finishing Horizontal Surfaces: Float and trowel horizontal (top) surfaces to level, smooth, uniform textured, dense finish, where surface is to remain exposed or receive coating, membrane or other thin-set finish. Otherwise, leave struckoff surface undisturbed; except scratch surfaces which are to receive concrete or mortar topping or setting bed, by raking with a stiff broom.

    a. Depress top of concrete backfill sufficiently so that supported work can be set in bed of mortar or sand as indicated.

9. Curbs: Provide monolithic finish on interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to hard, dense finish with corners, intersections and terminations slightly rounded and coved.

D. Form Removal and Surface Repairs:

1. Form Removal: Remove forms as soon as concrete has set and gained sufficient strength to ensure that neither removal of forms nor stress introduced by removal of support contributed by forms will result in damage to concrete.

    a. Retain forms on vertical surfaces of concrete for not less than three (3) days after concrete is placed.

    b. Retain forms supporting horizontal and angular bottom surfaces of concrete for not less than fourteen (14) days after concrete is placed, except where indicated for longer periods of support.

2. Unexposed Surfaces: Repair significantly damaged and honeycombed areas, and remove major projections and fins where forms have been removed.

3. Exposed Surfaces: On formed surfaces which are to be exposed, including those to be coated or covered with membrane or other thin-set applied finish, repair and patch form-tie holes and damaged and honeycombed areas, filling voids with grout and completely removing fins and other projections.

3.8 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from drying and excessively cold

and hot temperatures, and maintain in moist condition at relatively constant temperature for period of time necessary for hydration of cement, proper hardening, and achievement of strength requirements as specified.

a. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than seventy-two (72) hours.

b. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue curing for at least seven (7) days and in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

c. Subgrade concrete backfill may be excluded from final curing procedures where adjoining subsoil is sufficiently moist to maintain concrete in moist condition.

B. Curing Method: Perform final curing for each area of concrete work by one of the following methods (at Contractor's option), as appropriate for location and accommodation of adjacent construction work which must continue:

1. Continuous water emersion or fog spraying.

2. Covering with absorptive cover which is maintained in wet-to-fully saturated condition.

3. Covering with moisture retaining cover, with sealed joints and maintained without holes or openings as non-breathing membrane.

4. Coating with membrane-forming curing compound, applied in two (2) coats and maintained in effective condition for cure period (replaced if degraded by rain before reaching stable condition).

a. Do not use compound curing method where surface is to be painted, dampproofed, waterproofed, or covered with other finish requiring bond to concrete.

b. Do not use compound curing method where forms must be retained more than three (3) days.

3.9 MISCELLANEOUS CONCRETE WORK

A. Concrete Grouting: Grout openings and recesses as indicated, in and

around mechanical work and other work which penetrates or adjoins mechanical concrete work, using rough grouting class of concrete mix. Provide formwork where required, and tamp, screed and trowel surfaces. Cure grout as specified for concrete work.

B. Refer to individual equipment sections of these specifications for fine-grouting of equipment base plates on foundations (usually with non-shrinking grout), and similar grouting requirements not defined herein as concrete work.

3.10 QUALITY CONTROL TESTING

A. Engage testing laboratory to take samples, perform tests, and prepare and submit reports for concrete as it is placed.

1. Backfill Concrete: Quality control testing is not required for backfill concrete (lean concrete).

3.11 SURFACE PREPARATION FOR PAINTING

A. General: Clean surfaces before applying paint products. Remove oil and grease prior to mechanical cleaning. Comply with paint products manufacturer's instructions for surface cleaning and preparation. Remove surface-applied accessories which are not to be painted, and reinstall after completion of painting. Protect non-removable items not to be painted, by covering with paper or plastic material.

B. Cementitious Surfaces: Remove efflorescence, chalk, dust, and glaze to ensure good bond of paint products. Clean concrete with muriatic acid (1 part diluted with 6 to 8 parts water) and flush with water, where necessary to ensure good paint bond. Perform appropriate tests to determine that both alkalinity and moisture content of concrete surfaces are below maximum allowable levels for painting, as recommended by paint manufacturer.

C. Ferrous Metal Surfaces: Remove mill scale and loose rust on surfaces which are not zinc-coated or shop/factory prime coated.

D. Clean shop-applied prime coats on metal surfaces, and repair (touch-up) prime coats wherever abraded or otherwise damaged, prior to application of paint system.

E. Zinc-Coated Surfaces: Clean with non-petroleum based solvent. Wash with copper sulfate solution and flush with water, unless surface has been pretreated, or unless treatment is not recommended by manufacturer of

prime coat.

3.12 PAINT SYSTEM APPLICATION

A. Mixing: Comply with manufacturer's recommendations for mixing or stirring paint products immediately before application.

B. Application Limitations: Except as otherwise indicated, paint every accessible surface of each unit of work indicated to be painted, regardless of whether in location recognized as "concealed" or "exposed".

1. Omit painting on surfaces located in service shafts and tunnels and above non-removable ceilings and in similar place where space is too limited or services are too congested to allow access for painting.

2. Omit painting of insulated piping above removable ceilings, but apply paint system to uninsulated steel piping, exposed threads of galvanized piping, pipe hangers, and similar work.

3. Omit painting on machined sliding surfaces and rotating shafts of equipment, and on nonferrous finished metals including chrome plate, stainless steel, special anodized aluminum, brass/bronze and copper, and on plastics and similar finished materials, except where specifically indicated to be color-coded by painting.

4. Omit painting on required name plates, labels, identification tags, signs, markers, printed instructions, performance ratings, flow diagrams and similar text and graphics, located within the scope of work indicated to receive paint application.

5. Omit specified prime coat of paint system for metal surfaces where surface has shop-applied prime coat of equivalent quality. Apply prime coat on other surfaces to be painted; comply with paint manufacturer's instructions for prime coating where not otherwise indicated. Apply additional prime coats where suction spots or unsealed areas appear.

C. General Application Requirements: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate, for type of material being applied, and for ambient conditions. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Apply paint at edges, corners, joints, welds and exposed fasteners in manner which will ensure dry-film thickness equal to that of

flat surfaces. Allow sufficient time between successive coats for proper drying (comply with manufacturer's drying instructions).

D. Number of Coats: Number indicated is minimum number; apply as many coats as are necessary to comply with dry-film thickness requirements.

E. Coating Thickness: Apply uniform coats to produce dry-film thickness indicated or, if not otherwise indicated, apply paint without thinning in application thickness recommended by manufacturer for each coat.

F. Smooth Finishes: Except as otherwise indicated, apply paint in smooth finish without noticeable texture, cloudiness, spotting, holidays, laps, brush marks, runs, sags, ripples, ropiness and other surface imperfections.

G. Textured Finishes: Where indicated, roll and redistribute paint of final coat to even texture. Match adjoining textured paint finishes if any, and roll to eliminate evidence of roller or lap marks and other unevenness and imperfections.

H. Exterior Stacks: Paint the top 18" (450 mm) of stacks black, regardless of color selected for general painting of equipment and accessories on roof.

3.13 CLEAN-UP AND PROTECTION, PAINTING

A. General Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day. Retain paint containers from application of coatings on particular unit or area of work, until average dry-film thickness has been calculated.

B. Spattered Surfaces: Upon completion of painting work, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. Protection: Protect work of other trades, whether to be painted or not, against damage by painting work. Correct damage by cleaning, repairing or replacing and repainting as directed. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings installed for protection of work not to be painted, after completion of painting operations. At completion of work by other trades, touch-up and restore damaged or defaced painted surfaces.

END OF SECTION

SECTION 22 0513 - ELECTRICAL PROVISIONS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Types of work normally recognized as electrical, but provided as mechanical, specified or partially specified in this section, include but are not necessarily limited to the following:

1. Motors for mechanical equipment.

2. Motor starters and Variable Frequency Drives (VFDs) for mechanical equipment.

3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.

4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.

B. Refer to requirements of Division-26 sections.

1.2 QUALITY ASSURANCE

A. Coordination with electrical work: wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in division-26 sections for electrical work of this section which is not otherwise specified.

B. Standards: For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology herein. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.3 SUBMITTALS

A. Listing, Motors of Mechanical Work: Concurrently, with submittal of mechanical products listing (Basic Mechanical and Division-01 requirements), submit separate listing showing rating, power characteristics, application (connected equipment), and general

location of every motor to be provided with mechanical work. Submit updated information promptly when and if initial data is revised.

1. Include in listing of motors, notations of whether motor starter is furnished or installed integrally with motor or equipment containing motor.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Characteristics: Except where more stringent requirements are indicated, and except where required item of mechanical equipment cannot be obtained with fully complying motor, comply with the following requirements for motors of mechanical work:

B. Temperature Rating: Rated for 113 degrees F (40 degrees C) environment with maximum 122 degrees F (50 degrees C) temperature rise for continuous duty at full-load (Class B Insulation).

C. Starting Capability: Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than five (5) starts per hour for manually controlled motors.

D. Phases and Current Characteristics: Provide squirrel cage induction polyphase motors for 1/2 hp (.4 kW) and larger, and provide capacitor-start single-phase motors for 1/3 hp (.25 kW) and smaller, except 1/6 hp (.1 kW) and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division-26 sections, and with individual equipment requirements specified in other Division-22 requirements. For 2-speed motors provide two (2) separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.

E. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

F. Motor Construction: Provide general purpose, continuous duty motors, Class F insulation, Design "B" except "C" where required for high starting torque.

1. Bearings: Ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other

drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division-22 for fractional-hp light-duty motors where sleeve-type bearings are permitted.

2. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division-22 for other enclosure requirements.

3. Overload Protection: Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.

4. Noise Rating: Provide industry standard "Quiet" rating on motors.

5. Efficiency: For motors 1 horsepower (.7 kW) or higher, provide motors with minimum efficiencies as follows in accordance with IEEE Standard 112, Test Method B:

   a. Open Motors (ODP)

MOTOR HP (KW)	MINIMUM EFFICIENCY *		
	1200 RPM	1800 RPM	3600 RPM
1 (.7)	82.5%	85.5%	77.0%
1.5 (1.1)	86.5%	86.5%	84.0%
2 (1.5)	87.5%	86.5%	85.5%
3 (2.2)	88.5%	89.5%	85.5%
5 (4)	89.5%	89.5%	86.5%
7.5 (5.6)	90.2%	91.0%	88.5%
10 (8)	91.7%	91.7%	89.5%
15 (11)	91.7%	93.0%	90.2%
20 (15)	92.4%	93.0%	91.0%

25 (19)	93.0%	93.6%	91.7%
30 (22)	93.6%	94.1%	91.7%
40 (30)	94.1%	94.1%	92.4%
50 (38)	94.1%	94.5%	93.0%
60 (45)	94.5%	95.0%	93.6%
75 (56)	94.5%	95.0%	93.6%
100 (75)	95.0%	95.4%	93.6%
125 (94)	95.0%	95.4%	94.1%
150 (115)	95.4%	95.8%	94.1%
200 (150)	95.4%	95.8%	95.0%

* Required Full Load Nominal Efficiency shall be in accordance with EISA 2007. Where efficiency listed above is higher than the EISA 2007 requirement, provide the higher efficiency indicated.

b. Enclosed Motors (TEFC)

MOTOR HP (KW)	MINIMUM EFFICIENCY *		
	1200 RPM	1800 RPM	3600 RPM
1 (.7)	82.5%	85.5%	77.0%
1.5 (1.1)	87.5%	86.5%	84.0%
2 (1.5)	88.5%	86.5%	85.5%
3 (2.2)	89.5%	89.5%	86.5%
5 (4)	89.5%	89.5%	88.5%
7.5 (5.6)	91.0%	91.7%	89.5%
10 (8)	91.0%	91.7%	90.2%
15 (11)	91.7%	92.4%	91.0%
20 (15)	91.7%	93.0%	91.0%

25 (19)	93.0%	93.6%	91.7%
30 (22)	93.0%	93.6%	91.7%
40 (30)	94.1%	94.1%	92.4%
50 (38)	94.1%	94.5%	93.0%
60 (45)	94.5%	95.0%	93.6%
75 (56)	94.5%	95.4%	93.6%
100 (75)	95.0%	95.4%	94.1%
125 (94)	95.0%	95.4%	95.0%
150 (115)	95.8%	95.8%	95.0%
200 (150)	95.8%	96.2%	95.4%

* Required Full Load Nominal Efficiency shall be in accordance with EISA 2007. Where efficiency listed above is higher than the EISA 2007 requirement, provide the higher efficiency indicated.

c. Where fan or pump motors are used in conjunction with, or controlled by, a variable frequency drive (VFD), motors shall be suitable for VFD operation (inverter duty motors).

d. For motors less than 1 horsepower (.7 kW), provide motors with higher efficiency than "average standard industry motors," in accordance with IEEE Standard 112, test method B.

G. Nameplate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, special feature and similar information.

H. Motor Modifications: In cases where the equipment submitted requires additional motors and/or controls, circuiting and related equipment shall be provided as approved and in accordance with the National Electrical Code. All costs relative to these electrical changes shall be included under the Section in which the equipment is furnished and installed and shall be coordinated with the electrical work at no expense to the Owner.

I. Power Factor: All motors one (1) horsepower and above shall have a minimum power factor of 0.90.

J. All motors operated on variable frequency drives shall be equipped with a maintenance free, conductive microfiber, shaft grounding ring with a

minimum of two (2) rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings. Motors up to 100 HP shall be provided with a minimum of one (1) shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor pump manufacturer or contractor and shall be installed in accordance with the manufacturer's recommendations.

2.2 MOTOR STARTERS AND VARIABLE FREQUENCY DRIVES (VFDS)

A. Where motor starters and/or variable frequency drives (VFDs) are indicated for mechanical equipment, they shall comply with all requirements outlined with the electrical specifications for motor starters and VFDs. Where motor starters and/or VFDs are provided by the mechanical contractor, or as a portion of a packaged mechanical unit, the electrical specifications shall also apply. All VFDs for the project, whether provided by the mechanical or electrical contractor, shall be provided by a single manufacturer, and shall include the same features and options.

2.3 MECHANICAL EQUIPMENT

A. All mechanical equipment shall be approved and listed by Underwriters' Laboratories (UL) and shall bear nameplate indicating same.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp (.25 kW) and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Deliver starters and wiring devices which have not been factory installed on equipment unit to electrical Installer for installation.

C. Install furnished under Division-26 starter panels and wiring devices at

locations indicated, securely supported and anchored, and in accordance with manufacturer's installation instructions. Locate in accordance with National Electric Code for installation requirements.

END OF SECTION

SECTION 22 0514 - PIPE, TUBE AND FITTINGS FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of pipes and pipe fittings required by this section is indicated on drawings and/or specified in other Division-22 sections.

B. Types of pipes and pipe fittings specified in this section include the following:

1. Steel Pipes
2. Copper Tube
3. Cast-Iron Pressure Pipes
4. Cast-Iron Soil Pipes
5. Grooved Piping Products
6. Miscellaneous Piping Materials/Products

C. Pipes and pipe fittings furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Division-22 sections.

D. Refer to all Division-21 and -22 sections.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. Welding: Qualify welding procedures, welders and operators in accordance with ASME B 3 1.1, or ASME B 31.9, as applicable, for shop and project site welding of piping work.

    a. Certify welding of piping work using the Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).

2. Brazing: Certify brazing procedures, brazers and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX,

for shop and job-site brazing of piping work.

3. NSF Labels: Where plastic piping is indicated to transport potable water, provide pipes and pipe fittings bearing approval label by National Sanitation Foundation (NSF).

4. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

B. Pipe Testing Procedures: Contractor shall pressure test all piping systems in accordance with the following:

1. ASME Code for Pressure Piping B31, most current edition.

2. National Fire Protection Association (NFPA), all applicable sections, most current edition.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of pipe and pipe fitting. In addition, submit a matrix indicating each service and the proposed pipe material and fitting.

B. Welding Certifications: Submit reports as required for piping work.

C. Brazing Certifications: Submit reports as required for piping work.

D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of Division-01.

1.4 DELIVERY, STORAGE AND HANDLING

A. Except for hub-and-spigot and similar units of pipe, provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage, and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with

durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 GENERAL

A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service; where type, grade or class is not indicated. Provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.2 STEEL PIPES AND PIPE FITTINGS

A. Black Steel Pipe: ASTM A 53, A 106 or A 120; except comply with ASTM A 53 or A 106 where close coiling or bending is required.

B. Galvanized Steel Pipe: ASTM A 53 or A 120; except comply with ASTM A 53 where close coiling or bending is required.

C. Seamless Steel Pipe: ASTM A 53, A 106, or A 120; except comply with ASTM A 53 or A 106 where close coiling or bending is required.

D. Galvanized Seamless Steel Pipe: ASTM A 53 or A 120; except comply with ASTM A 53 where close coiling or bending is required.

E. Electric-Resistance-Welded Steel Pipe: ASTM A 135.

F. Electric-Fusion-Welded Steel Pipe: ASTM A 671, A 672, or A 691.

G. Stainless Steel Pipe: ASTM A 312; Grade TP 304.

H. Steel Water Pipe: AWWA C200 for pipe 6" (150 mm) and larger.

I. Coal Tar Protective Coatings and Linings for Steel Water Pipe: AWWA

C203 for enamel and tape, hot applied.

J. Cast-Iron Flanged Fittings: ANSI B16.1, including bolting.

K. Cast-Iron Threaded Fittings: ANSI B16.4.

L. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.

M. Malleable-Iron Threaded Unions: ANSI B16.39; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.

N. Threaded Pipe Plugs: ANSI B16.14.

O. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.

1. Material Group: Group 1.1.

2. End Connections: Buttwelding.

3. Facings: Raised-face.

P. Steel Pipe Flanges for Waterworks Service: AWWA C207.

Q. Corrosion-Resistant Cast Flanges/Fittings: MSS SP-51, including bolting and gasketing.

R. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11 except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.

S. Wrought-Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.

T. Stainless Steel Buttwelding Fittings: MSS SP-43.

U. Cast-Iron Threaded Drainage Fittings: ANSI B16.12.

V. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.

W. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining

unthreaded is less than 1-1/2" (40 mm), and where pipe size is less than 1-1/2" (40 mm), and do not thread nipples full length (no close-nipples).

2.3 COPPER TUBE AND FITTINGS

A. Copper Type: ASTM B 88; Type (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated.

B. DWV Copper Tube: ASTM B 306.

C. ACR Copper Tube: ASTM B 280.

D. Cast-Copper Solder-Joint Fittings: ANSI B16.18.

E. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.

F. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23.

G. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.

H. Cast-Copper Flared Tube Fittings: ANSI B16.26.

I. Bronze Pipe Flanges/Fittings: ANSI B16.24.

J. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.4 CAST-IRON PRESSURE PIPES AND PIPE FITTINGS

A. Ductile-Iron Pipe: ANSI A21.51; AWWA C151.

B. Polyethylene Encasement for Gray and Ductile Cast-Iron Piping: ANSI A21.5; AWWA C105.

C. Cast-Iron Fittings: AWWA C110.

D. Gray-Iron Fittings: AWWA C110.

E. Ductile-Iron Fittings: AWWA C110.

F. Rubber-Gasket Joints: AWWA C111.

2.5 CAST-IRON SOIL PIPES AND PIPE FITTINGS

A. Hubless Cast-Iron Soil Pipe: FS WW-P-401.

B. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74.

C. Hubless Cast-Iron Soil Pipe Fittings: Neoprene gasket complying with ASTM C 564 and stainless steel clamp holding band.

D. Cast-Iron Hub-and-Spigot Soil Pipe: Match soil pipe units; complying with same standards (ASTM A 74).

E. Compression Gaskets: ASTM C 564.

F.

2.6 GROOVED PIPING PRODUCTS

A. General: As Installer's option, mechanical grooved pipe couplings and fittings may be used only in mechanical rooms and areas where piping is installed above acoustic tile ceilings for the following systems in lieu of welded, flanged or threaded methods:

1. Fire protection

2. Domestic water

B. Coupling Housings:

1. Coupling Housings: Malleable iron conforming to ASTM A 47.

2. Coupling Housings: Ductile iron conforming to ASTM A 536.

C. Coupling Housings Description: Grooved mechanical type, which engages roll grooved pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature.

D. Gaskets: Mechanical roll grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D 2000.

1. Water Services: EDPM Grade E, with green color code identification.

2. Other Services: As recommended by manufacturer.

E. Bolts and Nuts: Heat-treated carbon steel, ASTM A 183, minimum tensile 110,000 psi (758420 kPa).

1. Exposed Locations: Tamper resistant nuts.

F. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.

G. Fittings: Roll grooved end design to accept grooved mechanical couplings.

1. Malleable Iron: ASTM A 47.

2. Ductile Iron: ASTM A 536.

3. Fabricated Steel: ASTM A 53, Type F for 3/4" (20 mm) to 1-1/2" (40 mm): Type E or S, Grade B for 2" (50 mm) to 20" (500 mm).

4. Steel: ASTM A 234.

H. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt hole alignment.

1. Malleable Iron: ASTM A 47.

2. Ductile Iron: ASTM A 536.

I. Roll Grooves: Conform to the following:

1. Lightweight Steel: Roll grooved.

2.7 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.

1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements.

1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.

2. Silver Solder: ASTM B 32, Grade 96TS.

C. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.

1. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.

D. Gaskets for Flanged Joints: ANSI B16.21; full-faced or cast-iron raised face for steel flanges, unless otherwise indicated.

E. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" (1.6 mm) misalignment tolerance.

1. Comply with ANSI B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Where trapping is unavoidable, install drain valve with 3/4" (20 mm) hose end connection, cap and chain. Provide access panels as required. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent enclosure elements of building; limit clearance to 1/2" (13 mm) where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" (25 mm) clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended

ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Exposed piping in finished areas shall be covered with a 16 gauge steel cover primed and painted, secured to an adjacent structure and painted to match adjacent surfaces.

D. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

3.2 PIPING SYSTEM JOINTS

A. General: Provide joints of type indicated in each piping system.

1. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

2. Braze copper tube-and-fitting joints where indicated, in accordance with ASME B31.

3. Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

B. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.

C. Weld pipe joints in accordance with recognized industry practice and as follows:

1. Weld pipe joints only when ambient temperature is above 0°F (-18°C) where possible.

2. Bevel pipe ends at a 37.5˚ angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.

3. Use pipe clamps or tack-weld joints with 1" (25 mm) long welds; 4

welds for pipe sizes to 10" (250 mm), 8 welds for pipe sizes 12" (300 mm) to 20" (500 mm).

4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.

5. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.

6. At Installer's option, install forged branch-connection fittings wherever branch pipe is indicated; or install regular "T" fitting.

7. At Installer's option, install forged branch-connection fittings wherever branch pipe of size smaller than main pipe is indicated; or install regular "T" fitting.

D. Weld pipe joints of steel water pipe in accordance with AWWA C206.

E. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

F. Lead Joint Installation: Tightly pack joint with joint packing material. Do not permit packing to enter bore of finished joint. Clean joint after packing. Fill remaining joint space with one pouring of lead to indicated minimum depth measured from face of bell. After lead has cooled, caulk joint tightly by use of hammer and calking iron.

G. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions.

H. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:

1. Heat Joining of Thermoplastic Pipe: ASTM D 2657.

2. Making Solvent-Cemented Joints: ASTM D 2235, and ASTM F 402.

I. Glass Pipe Joints: Comply with manufacturer's instructions and recommendations.

J. Open Drain-Tile Joints: Except as otherwise indicated, provide 1/4" (6 mm) open joint with top 2/3 of annular space covered by joint accessory material.

K. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

3.3 PIPING INSTALLATION

A. Install drain tile piping from lowest end of slope to highest, solidly bedded in filtering or drainage fill. Shape bed for bells of piping (if any). Place bells/hubs and grooved ends of units up-stream. Lay perforated pipe with perforations down. Refer to Division-2 specifications for filter cloth, bedding material and backfill installation requirements.

B. Install ductile cast-iron water mains and appurtenances in accordance with-AWWA C600.

3.4 RADIOGRAPHIC (X-RAY) TESTING

A. Field weld joints for all black steel pipe shall be radiographically (x-ray) tested to the extent identified below.

B. Testing shall be conducted by an independent testing company. The testing company shall provide arrest report identifying the results of each weld tested (pass/fail).

C. The Contractor shall engage the Owner and Engineer of Record to identify welds to be tested.

D. Testing:

1. If the total quantity of field welds is greater than 50, test 10% of field welds.

2. If the total quantity of field welds is less than 50, test 25% of field welds.

3. Should any of the initial welds tested fail, Contractor will be required to test an additional 20% of all remaining welds, at no additional cost to the Owner.

4. Should any of the additional 20% of welds tested fail, Contractor will be requested to test 100% of all remaining welds, at no additional cost to the Owner.

3.5 PIPE TESTING

A. The mechanical contractor shall air and/or hydrostatically test the following systems in accordance with the latest ASME B31 (ASME Code for Pressure Piping) and NFPA requirements.

1. Air Test:

a. Air, Gas and Vacuum

2. Hydrostatic Test:

a. Domestic Water

B. Pressure tests shall also be performed prior to the installation of all insulation materials.

C. Hydrostatic Test: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed, wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

1. Required test period is four (4) hours.

2. Hydrostatically test each piping system at 150% of operating pressure indicated, but not less than 100 psi (690 kPa) test pressure.

3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds less than zero percent (0.0%) of test pressure.

4. Upon completion of roughing-in and before setting fixtures, the entire new domestic water system shall be tested. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system.

5. Prior to testing, verify the pressures listed above are in accordance with the latest ASME B31 code and NFPA. Should a discrepancy exist between the ASME B31 code, NFPA, and/or the pressures indicated above, contact the Engineer prior to testing.

D. Air Test:

1. Air, gas and vacuum piping shall be air tested at 200 psi (1380 kPa).

2. Prior to testing, verify the pressures listed above are in accordance with the latest ASME B31 code and NFPA. Should a discrepancy exist between the ASME B31 code, NFPA, and/or the pressures indicated above, contact the Engineer prior to testing.

3. Required test period is four (4) hours.

4. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds less than zero percent (0.0%) of test pressure.

E. Sanitary and Storm Water Piping Systems:

1. All soil, waste, vent and storm water piping shall be tested by the Contractor and reviewed by the Architect before acceptance. All piping located underground shall be tested before backfilling. The costs of all equipment required for tests are to be included under the contract price.

2. The entire new drainage system and venting system shall have all necessary openings plugged and filled with water to the level of the highest vent stack above the roof or to the maximum pressure rating of the joint used. The system shall hold this water for four (4) hours without showing a drop in water level. Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except a vertical stack 10 feet (3000 mm) above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure.

3. Where sections are tested, overlap the sections so that all joints are subjected to the test procedures.

F. Drain test water from piping systems after testing and repair work has been completed.

G. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

H. Contractor shall submit pipe leakage test results to the A/E within 72 hours of completed tests. Only test results that meet the specified leakage requirements shall be submitted. Pipe test results shall be recorded on the attached "Piping Leakage Test Summary Form - Plumbing" at the end of

this section; no other forms will be accepted. In addition, the pipe leakage submittals shall include 11x17 drawing(s) as required to clearly indicate the full extent of the pipe test section (each pipe test section shall be numbered and color coded).

I. All pipe leakage test results shall be included with the final TAB report and the O&M Manual.

3.6 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31.

B. Disinfect water mains and water service piping in accordance with AWWA C601.

C. After final testing for leaks, all new potable water lines shall be thoroughly flushed by plumbing contractor to remove foreign material. Before placing the systems in service, Contractor shall engage a qualified service organization, to sterilize the systems in accordance with the following procedure:

1. Through a 3/4" (20 mm) hose connection in the main entering the building, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 PPM. Plumbing contractor shall provide plumbing connections and power for pumping chlorine into the system.

2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.

3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 PPM chlorine, retain this water in the system for three hours. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system.

4. At the end of the retention period, no less than 100 PPM of chlorine shall be present at the extreme end of the system.

5. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 PPM.

6. Obtain representative water samples from the system for analysis by a recognized bacteriological laboratory.

7. If the sample tested for coliform organisms is negative, a letter and laboratory reports shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization.

8. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.

END OF SECTION

PIPING LEAKAGE TEST SUMMARY FORM
(PLUMBING)

Project Name: _____ Project Number: _____ Page ____ of ____

System Tested	Sections Tested (1)	System Operating Pressure	Test Pressure (PSI/FT-HD) (2)	Duration (3)	Pressure Drop (4)	Pass/Fail

Name of Testing Agency/Company: _____
Date of Test(s): _____
Test Conducted By (Print/Sign): _____

(1) Identified by an 11 x 17 numbered and color coded test section plan. Plan shall accompany this test report.
(2) 150% of operating pressure but not less than 100 psi , 200 psi for air-gas-vacuum, 10 ft. static head pressure or to the maximum rating of the joint. Include joint cut sheets showing their ratings.
(3) Four (4) hours minimum.
(4) Shall not exceed 0.0%.

SECTION 22 0515 - PIPING SPECIALTIES FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of piping specialties work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Types of piping specialties specified in this section include the following:

1. Pipe Escutcheons
2. Pipeline Strainers
3. Vandal-Proof Vent Caps
4. Dielectric Fittings
5. Mechanical Sleeve Seals
6. Penetration Seals
7. Water Hammer Arresters
8. Drip Pans
9. Pipe Sleeves
10. Sleeve Seals
11. Flexible Connector
12. Domestic Water Mixing Valve

C. Piping specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-22 sections.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. FCI Compliance: Test and rate "Y" type strainers in accordance with FCI 73-1 "Pressure Rating Standard for "Y" Type Strainers". Test and

rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than "Y" Type".

2. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

B. Shop Drawings: Submit for fabricated specialties, indicating fabrication, materials, and method of support.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop drawings in maintenance manual.

PART 2 - PRODUCTS

2.1 PIPING SPECIALTIES

A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections.

2.2 PIPE ESCUTCHEONS

A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or

chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

2.3 LOW PRESSURE Y-TYPE PIPELINE STRAINERS

A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi (850 kPa) working pressure, with Type 304 stainless steel screens, with perforations as follows:

1. Piping 2" (50 mm) and Smaller: 1/32" (.8 mm) diameter perforations.

2. Piping 2-1/2" (65 mm) and Larger: 3/64" (1.2 mm) diameter perforations for water systems and 1/16" diameter perforations for steam systems.

B. Threaded Ends, 2" (50 mm) and Smaller: Brass, screwed screen retainer with centered blowdown fitted with valve and pipe plug.

C. Threaded Ends, 2-1/2" (65 mm) and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with valve and pipe plug.

D. Flanged Ends, 2-1/2" (65 mm) and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with valve and pipe plug.

E. Butt Welded Ends, 2-1/2" (65 mm) and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with valve and pipe plug.

F. Grooved Ends, 2-1/2" (65 mm) and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

2.4 HIGH PRESSURE Y-TYPE PIPELINE STRAINERS

A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 250 psi 1724 kPa) working pressure, with Type 304 stainless steel screens, with 3/64" (1.2 mm) perforations @ 233 per sq. in.

B. Threaded Ends, 2" (50 mm) and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with valve and pipe plug.

C. Threaded Ends, 2-1/2" (65 mm) and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with valve and pipe plug.

D. Flanged Ends 2-1/2" (65 mm) and Larger: Cast-iron body, bolted steel retainer with off-center blowdown fitted with valve and pipe plug.

E. Butt Welded Ends, 2-1/2" (65 mm) and Larger: Schedule 80 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with valve and pipe plug.

2.5 VANDAL-PROOF VENT CAPS

A. General: Provide cast-iron vandal-proof vent caps, full size of vent pipe, caulked base connection for cast-iron pipes, threaded base for steel pipes.

2.6 DIELECTRIC FITTINGS

A. General: Provide assembly or fitting having insulating material to isolate dissimilar metals to prevent galvanic action and stop corrosion.

1. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

    a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig (1035 kPa or 2070 kPa) minimum working pressure to suit system pressures.

2. Dielectric Nipples: Electroplated steel nipple, having inert and non-corrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig (2070 kPa) working pressure at 225°F (107°C) temperature.

3. Dielectric unions shall NOT be acceptable.

2.7 MECHANICAL SLEEVE SEALS

A. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber

sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.8 PENETRATION SEALS

A. Provide seals for all openings through fire-rated walls, floors, or ceilings used as passage for mechanical piping. See Division-22 Section "Basic Plumbing Materials and Methods" for penetration seals and firestopping requirements.

B. Provide seals for all openings through walls, floors or ceilings used as passage for mechanical components such as piping.

2.9 WATER HAMMER ARRESTERS

A. General: Provide bellows type water hammer arresters, stainless steel casing and bellows, pressure rated for 250 psi (1724 kPa), tested and certified in accordance with PDI Standard WH-201.

2.10 FABRICATED PIPING SPECIALTIES

A. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2" (65 mm). Reinforce top, either by structural angles or by rolling top over 1/4" (6 mm) steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" (25 mm) drain line connection.

B. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gages: 3" (75 mm) and smaller, 20 gage (1.0 mm); 4" to 6" (100 mm to 150 mm), 16 gage (1.6 mm); over 6" (150 mm), 14 gage (2 mm).

2. Steel-Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

3. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe; remove burrs.

2.11 FLEXIBLE CONNECTORS

A. Furnish and install braided stainless steel flexible connectors on the inlet and outlet of each pump, chiller, cooling tower, and all other piping

connected to a vibrating piece of equipment. Construction shall be of annular corrugated stainless steel close-pitch hose with stainless steel overbraid.

1. The corrugated metal hose, braids, and a stainless steel ring-ferrule/band (material gauge not less than .048") (material gauge not less than 1.2 mm) shall be integrally welded using a 100% circumferential, full-penetration TIG weld.

2. End fittings shall be flat-face plate steel flanges with 150# ANSI drilling and outside diameter. Fittings shall be attached using a 100% circumferential TIG/MIG weld.

3. Braided stainless steel connectors shall be suitable for operating temperatures up to 850°F (454°C).

4. The rated working pressure of braided metal hose shall have a minimum 4:1 safety factor based on an operating temperature of 70°F (20°C). Each braided stainless steel connector shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure.

5. Flanged connectors shall be prepared for shipment using cut-to-length spacers, securely positioned between the flanges to prevent axial compression damage and maintain the manufactured length. Spacers must be removed prior to system start-up.

6. All braided stainless steel connectors shall be covered by a three (3) year warranty.

7. Minimum overall lengths shall be as follows:

Through 4" (100 mm) diameter:	9" (225 mm)
5" (125 mm), 6" 150 mm) diameter:	11" (275 mm)
Over 6" (150 mm) diameter:	1.5 times nominal diameter

2.12 DOMESTIC WATER VALVE

A. Thermostatic and Pressure Mixing Valve:

1. Furnish and install where indicated on the floor plans. Refer to floor plans/details for manufacturer, size, model and setting. Mixing valve for tempered water controls shall be of the thermostatic type with liquid sensor and shall be in accordance with ASSE 1017. Valve shall

be constructed of a bronze body with internal non-corrosive parts. Valve construction shall employ poppets which are independently seated, balanced, and self-aligning. Union inlets with strainers and check stops shall be provided. Temperature adjustment control shall be tamper-resistant. Provide thermometer on outlet and valved inlets.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

B. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2" (50 mm) and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shutoff valve to drain, full size of blow down connection.

1. Locate Y-type strainers ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:

a. Pumps

b. Pressure reducing valves

c. Temperature or pressure regulating valves

C. Vandal-Proof Vent Caps: Install vandal-proof vent caps on each vent pipe passing through roof, and elsewhere as indicated. Locate base of vent cap 6" (150 mm) above roof surface, or higher where required by Code.

D. Dielectric Fittings: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

E. Mechanical Sleeve Seals: Provide mechanical sleeve seals for sleeves located in foundation walls below grade, or in exterior walls. Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts

until links have expanded to form watertight seal.

F. Water Hammer Arresters: Install in upright position, in locations and of sizes in accordance with PDI Standard WH-201, and elsewhere as indicated.

3.2 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Drip Pans: Locate drip pans under piping passing over or within 3' (0.9 m) horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" (25 mm) drain line to drain connection, and run to nearest drain as indicated.

B. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by the Owner. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Sleeves through floors shall be flush with the floor, except for sleeves passing through equipment rooms, toilet rooms (and other wet areas) which shall extend 3/4" (20 mm) above the floor. Space between the pipe and sleeve shall be caulked. Escutcheons plates shall be constructed to conceal the ends of sleeves. Extend floor sleeves 1/4" (6 mm) above level floor finish and 3/4" (20 mm) above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

1. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings.

2. Install iron-pipe sleeves at exterior and interior foundation wall penetrations, both above and below grade. Penetrations shall be sealed weathertight.

3. Install steel-pipe except as otherwise indicated.

3.3 INSTALLATION OF FLEXIBLE PIPE CONNECTORS

A. Provide flexible pipe connectors on the inlet and outlet of piping

connected to a vibrating piece of equipment. Flexible connectors shall be full line size as indicated on the drawings and should be provided with control rods.

END OF SECTION

SECTION 22 0519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of meters and gauges required by this section is indicated on drawings and/or specified in other division-22 sections.

B. Types of meters and gauges specified in this section include the following:

1. Temperature Gauges and Fittings:

a. Direct Mount Dial Thermometers

b. Remote Reading Dial Thermometers

c. Thermometer Wells

2. Pressure Gauges and Fittings:

a. Pressure Gauges

b. Pressure Gauge Cocks

c. Pressure Gauge Connector Plugs

C. Meters and gauges furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division-22 sections.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.

2. ANSI and ISA Compliances: Comply with applicable portions of American National Standards Institute (ANSI) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

3. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use

devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

B. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge. Include this data in Maintenance Manual.

PART 2 - PRODUCTS

2.1 DIRECT MOUNT DIAL THERMOMETERS

A. General: Provide direct mount dial thermometers of materials designed and constructed for use in service indicated.

B. Type: Vapor tension, universal angle.

C. Case: Drawn steel or brass, glass lens, 5" (125 mm) diameter. For gauges mounted above eight feet (2400 mm), 8" (200 mm) diameter gauge.

D. Adjustable Joint: Die cast aluminum, 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal plane, with locking device.

E. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube, one scale division accuracy.

F. Movement: Brass precision geared.

G. Scale: Progressive, satin faced, non-reflective aluminum, permanently etched markings.

H. Stem: Copper plated steel, or brass, for separable socket, length to suit installation.

I. Range: Conform to the following:

1. Hot Water: 30°F - 240°F (-1°C - 116°C).

2.2 REMOTE READING DIAL THERMOMETERS

A. General: Provide remote reading dial thermometers of materials designed and constructed for use in service indicated.

B. Type: Vapor tension.

C. Case: Drawn steel or brass, glass lens, 5" (125 mm) diameter. For gauges mounted above eight feet (2400 mm), 8" (200 mm) diameter shall be used.

D. Movement: Brass, precision geared.

E. Tubing: Bronze double braided armor over copper capillary, length to suit installation.

F. Bulb: Copper with separable socket for liquids, averaging element for air.

G. Accuracy: + one scale division.

H. Range: Conform to the following:

1. Hot Water: 30°F - 240°F (-1°C - 116°C).

2.3 THERMOMETER WELLS

A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" (50 mm) extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

B. Manufacturer: Same as thermometers.

2.4 PRESSURE GAUGES

A. General: Provide pressure gauges of materials designed and constructed for use in service indicated.

B. Type: General use, 1% accuracy, ANSI B 40.1 Grade A, phosphor bronze bourdon type, bottom connection.

C. Case: Drawn steel or brass, glass lens, 5" (125 mm) diameter. For gauges mounted above eight feet (2400 mm), 8" (200 mm) gauges shall be used.

D. Connector: Brass with 1/4" (6 mm) male NPT. Provide protective syphon when used for steam service.

E. Scale: White coated aluminum, with permanently etched markings.

F. Range: Conform to the following:

1. Water: 0 - 100 psi (0 - 690 kPa).

2.5 PRESSURE GAUGE COCKS

A. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Construct gauge cock of brass with 1/4" (6 mm) female NPT on each end, and "T" handle brass plug.

B. Syphon: 1/4" (6 mm) straight coil constructed of brass tubing with 1/4" (6 mm) male NPT on each end.

C. Snubber: 1/4" (6 mm) brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

D. Manufacturer: Same as for pressure gauges.

2.6 PRESSURE GAUGE CONNECTOR PLUGS

A. General: Provide pressure gauge connector plugs pressure rated for 500 psi (3448 kPa) and 200°F (93°C). Construct of brass and finish in nickel plate, equip with 1/2" (13 mm) NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" (3 mm) O.D. probe assembly from dial type insertion pressure gauge. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TEMPERATURE GAUGES

A. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor.

B. Locations: Install direct mounted thermometers in the following locations, and elsewhere as indicated:

1. At suction and discharge of each pump.

2. At discharge of each domestic water heater.

C. Remote Reading Dial Thermometers: Install on control panels as indicated. Run tubing between panel and thermometer bulb, adequately supported to prevent kinks. Select tubing length so as to not require coiling of tubing.

D. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical upright position. Fill well with oil or graphite, secure cap.

3.3 INSTALLATION OF PRESSURE GAUGES

A. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated:

1. At suction and discharge of each pump.

2. At inlet and outlet of each pressure reducing valve.

3. At incoming services (domestic water, fire and gas).

4. At inlet and outlet of large strainers.

5. At inlet of expansion tanks.

6. At inlet and outlet of domestic water booster pump package.

7. At inlet and outlet of backflow preventers.

C. Pressure Gauge Cocks: Install in piping tee with snubber.

D. Pressure Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows and repair any scratched or marred surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 22 0523 - VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of valves required by this section is indicated on drawings and/or specified in other Division-22 sections.

B. Types of valves specified in this section include the following:

1. Gate Valves
2. Globe Valves
3. Drain Valves
4. Ball Valves
5. Check Valves

C. System Descriptions:

1. Domestic Water Piping: Domestic water piping shall relate to potable and non-potable cold water, hot water and hot water recirculating piping systems.

D. Valves furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division-22 sections.

1.2 QUALITY ASSURANCE

A. Valve Types: Provide valves of same type by same manufacturer.

B. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating and size clearly marked on valve body.

C. Codes and Standards:

1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".
2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged or welded-end valve bodies, comply with ANSI B16.10

"Face-to-Face and End-to-End Dimensions of Ferrous Valves".

3. UL and FM Compliance: Provide valves used in fire protection piping, which are UL-listed and FM approved.

4. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61- G).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve.

B. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of valve. Include this data, product data, and shop drawings in Maintenance Manual.

PART 2 - PRODUCTS

2.1 VALVES - GENERAL

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work, shall be limited to the following, unless otherwise noted:

1. Milwaukee

2. Bray

3. Apollo

4. DeZurik

5. Jamesbury

6. Watts

B. Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

C. Size: Unless otherwise indicated, provide valves of same size as upstream pipe size. Pipe size reduction shall be made after valve assembly.

D. Valve Features: Provide the following as required:

1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.

2. Bypass: Comply with MSS SP-45, and except as otherwise indicated, provide manufacturer's standard bypass piping and valving.

3. Drain: Comply with MSS SP-45, and provide threaded pipe plugs.

4. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5, (steel), or ANSI B16.24 (bronze).

5. Threaded: Valve ends complying with ANSI B2.1.

6. Butt-Welding: Valve ends complying with ANSI B16.25.

7. Socket-Welding: Valve ends complying with ANSI B16.11.

8. Solder-Joint: Valve ends complying with ANSI B16.18.

9. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

10. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6" (150 mm) and smaller. Provide gear operators for quarter-turn valves 8" (200 mm) and larger. Provide chain-operated sheaves and chains for overhead valves as indicated.

2.2 GATE VALVES

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-70.

2. Bronze Valves: MSS SP-80.

3. Steel Valves: ANSI B16.34.

B. Fire Protection and Incoming Water Services:

1. Threaded End; 2" (50 mm) and Smaller: FM, UL-listed, 175 psi (1200 kPa), bronze body, solid wedge, outside screw and yoke, rising stem. Milwaukee Model 118 or equivalent.

2. Flanged End; 2-1/2" (65 mm) and Larger: FM, UL-listed, 175 psi (1200 kPa), iron body bronze mounted, solid wedge, outside screw and yoke, rising stem. Milwaukee Model F2885FP or equivalent.

2.3 GLOBE VALVES

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-85.

2. Bronze Valves: MSS SP-80.

3. Steel Valves: ANSI B16.34.

B. Domestic Water Piping:

1. 2" (50 mm) and Smaller: Class 150, bronze body, union bonnet, integral seat, renewable TFE disc. Milwaukee Model 590T (Threaded), 1590T (Sweat) or equivalent.

2. Flanged Ends; 2-1/2" (65 mm) and Larger: Class 125, iron body, bolted bonnet, renewable seat and disc, bronze mounted. Milwaukee Model F2981A or equivalent.

2.4 DRAIN VALVES

A. Comply with the following standards:

1. Water Heater Drain Valves: ASSE 1005.

B. Domestic Water Piping:

1. 3" (75 mm) and Smaller: Class 125, bronze body ball valve with chrome plated ball, hose end with cap and chain. Milwaukee BA100H (Threaded), Milwaukee BA150H (Sweat) or equivalent.

2.5 BALL VALVES

A. Comply with the following standards:

1. Bronze Valves: MSS SP-110.

2. Potable Water: NSF-61-8.

B. Domestic Water Piping:

1. 2" (50 mm) and Smaller: Valves shall be rated 150 psi (1035 kPa) SWP and 600 psi (4140 kPa) non-shock WOG and shall have 2-piece cast ASTM B 584 bronze bodies, TFE seats, standard port, separate packing nut with adjustable stem packing, anti-blowout stems and stainless steel ball. Valve ends shall have full depth ANSI threads or extended solder connections and be manufactured to comply with MSS-SP110. Milwaukee BA100S (Threaded), BA150S (Sweat) or equivalent. For potable water applications provide NSF/ANSI 1372 (NSF-61-G) compliant "lead free" valves; Milwaukee UPBA 100/150 or equivalent.

C. Natural Gas Service:

1. 2" (50 mm) and Smaller: 600 lb WOG, 150 lb SWP, 2 piece body style, full port, chrome plated ball, bronze body of ASTM B283 forged brass body, hex gland follower, blow out proof stem, lever handle. Valves shall be CSA, UL and FM approved. Milwaukee BA 475 (Threaded) or equivalent.

2. 2-1/2" (65 mm) and larger: Consult valve manufacturer for suggested valve over 2" for gas service (Milwaukee does not offer a gas agency approved valve over 2")

D. Where piping is insulated, ball valves shall be equipped with 2" (50 mm) extended handles of non-thermal conductive material. Also, provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.

2.6 CHECK VALVES

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-71.

2. Bronze Valves: MSS SP-80.

3. Steel Valves: ANSI B16.34.

B. Domestic Water Piping:

1. 2" (50 mm) and Smaller: Class 150, bronze body, horizontal swing, T pattern with renewable TFE disc. Milwaukee 510T (Threaded), 1510T (Sweat) or equivalent.

2. 2-1/2" (65 mm) and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Milwaukee F2974A or equivalent.

C. Fire Protection:

1. 2-1/2" (65 mm) and Larger; FM: 175 psi (1200 kPa), iron body bronze mounted, renewable composition disc and bronze seat ring, bolted cover, flanged ends. Milwaukee F2974FP or equivalent.

2.7 BALANCE VALVES

A. Plumbing: For potable water applications, valves shall be "lead-free" in accordance with local, state and federal codes, as well as, NSF/ANSI 372 (NSF 61-G). Balance valves for hot water recirculating systems shall be venturi type with an accuracy of 3% at full scale; RWV or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Except as otherwise indicated, comply with the following requirements.

1. Install valves where required for proper operation of piping and equipment, including valves in branch lines, service mains and all equipment connections. Locate valves so as to be accessible and so that separate support can be provided when necessary.

2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Mechanical Actuators: Install mechanical actuators with chain operators where indicated. Extend chains to approximately five feet (1500 mm) above floor and secure to clips to clear aisle passage.

D. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with connections to match pipe fittings.

E. Renewable Seats: Install valves with renewable seats, where applicable.

F. Fluid Control: Except as otherwise indicated, install gate, ball, globe, and butterfly valves to comply with ANSI B31.9. Where throttling is indicated or recognized as principle reason for valve, install ball, globe or butterfly valves, as indicated.

G. Installation of Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.

3.2 ADJUSTING AND CLEANING

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Valve Identification: Tag each valve in accordance with Division-22 section "Identification for Plumbing Piping and Equipment".

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of hangers and supports required by this section is indicated on drawings and/or specified in other Division-22 sections.

B. Types of hangers and supports specified in this section include the following:

1. Horizontal-Piping Hangers and Supports
2. Vertical-Piping Clamps
3. Hanger-Rod Attachments
4. Building Attachments
5. Saddles and Shields
6. Spring Hangers and Supports
7. Miscellaneous Materials
8. Anchors
9. Equipment Supports

C. Hangers and supports furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division-22 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hangers and supports, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable codes pertaining to product materials and installation of hangers and supports.

2. NFPA, UL, and FM Compliance: Provide products which comply with NFPA 13 listed and labeled by UL and FM where used for fire protection piping systems.

3. MSS Standard Compliance:

   a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

   b. Select and apply pipe hangers and supports, complying with MSS SP-69.

   c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

   d. Terminology used in this section is defined in MSS SP-90.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe hanger and support.

PART 2 - PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, selected by Installer to suit horizontal-piping systems in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.2 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SP-58, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated hangers and supports for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.3 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.4 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems. Provide copper-plated hangers and supports for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper

piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.5 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

2.6 SPRING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

2.7 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2).

D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which hangers and supports are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

A. Install attachments at required locations within concrete steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi (17240 kPa) is indicated, install reinforcing bars through openings at top of inserts.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire-water piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

E. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

H. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold water piping, install coated protective shields.

3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

4. For all insulated piping 2-1/2" (63 mm) and larger, provide insulated saddles as follows:

a. For domestic hot and cold water piping, provide the following:

b. Minimum 3.75 pcf, non-compressive, rigid, phenolic foam insulation. Fire and smoke rating shall be 25/50 or below per ASTM 84.

c. For cold applications below 75ºF (24ºC) a zero permeability, abuse resistant, vapor barrier shall be provided with matching butt strips. Apply a full coating of butyl joint sealant in addition to the butt strips for a completely sealed system.

d. The phenolic foam system shall have a K factor of 0.16 at a mean temperature for 75ºF (24ºC) and comply with ASTM Standard C1126.

e. Provide visible inspection sticker at the bottom of each saddle.

f. Pipe insulation saddles shall be Tru-Balance CoolDry Saddles as manufactured by Buckaroos, Inc. or equivalent.

I. Spacing: Hanger spacing for piping shall not exceed 8 feet (2400 mm) on centers for pipe 1-1/4" (32 mm) or smaller, and 10 feet (3 m) for pipe 1-1/2" (40 mm) and larger. Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping. For cast iron soil pipe, one hanger shall be placed at each hub or bell.

3.4 ADJUSTMENT OF HANGERS AND SUPPORTS

A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

3.5 EQUIPMENT SUPPORTS

A. Provide concrete housekeeping bases for all floor mounted equipment furnished as part of the work of Division-22. Size bases to extend minimum of 4" (100 mm) beyond equipment base in any direction; and 4" (100 mm) above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

3.6 PAINTING

A. All hangers, supports, clamps and assemblies shall be primed and painted with rust inhibitors.

END OF SECTION

SECTION 22 0549 - SEISMIC AND WIND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section specifies the minimum requirements for restraining Plumbing and Fire Protection systems and equipment.

B. The requirements of this section must be coordinated with the requirements of Division-22 section, Vibration Isolation for Plumbing Piping and Equipment.

C. This Section includes the following:

1. Restrained elastomeric isolation mounts
2. Restrained spring isolators
3. Restrained vibration isolation roof curb/rail assemblies
4. Restraint snubbers
5. Restraining braces and cables
6. Flexible connectors for restraint applications

1.3 APPLICABLE STANDARDS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

D. ASCE-7: Minimum Design Loads for Buildings and Other Structures.

1.4 PERFORMANCE REQUIREMENTS

A. All components mounted outside of the building structure shall be mounted to resist minimum wind loads per IBC requirements.

B. Wind-Restraint Loading:

1. Basic Wind Speed: See Structural Drawing General Notes.

2. Building Classification Category: See Structural Drawing General Notes.

3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by the maximum area of the plumbing component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

C. All Plumbing and Fire Protection components shall be mounted to resist seismic loads per IBC requirements.

D. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: See Structural Drawing General Notes.

2. Assigned Seismic Building Occupancy Category as Defined in the IBC: See Structural Drawing General Notes.

a. Component Importance Factor: See Schedule in Part 3 of this Section.

b. Component Response Modification Factor: Per ASCE-7 Table 13.6-1.

c. Component Amplification Factor: Per ASCE-7 Table 13.6-1.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Structural Drawing General Notes.

4. Design Spectral Response Acceleration at 1.0-Second Period: See Structural Drawing General Notes.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Illustrate and indicate style, material, strength, fastening provision,

and finish for each type and size of restraint component used.

B. Delegated-Design Submittal: For restraint details indicated to comply with performance requirements and design criteria, include project specific load analysis data signed and sealed by the qualified professional engineer responsible for their preparations. Design shall be per ASCE-7 requirements.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation and seismic and wind forces required to select restraints.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.

3. Seismic and Wind Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and/or wind restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic and/or wind load events. Indicate association with vibration isolation devices.

c. Coordinate seismic and/or wind restraint details required for equipment mounted outdoors. Comply with requirements in other Division-22 Sections for equipment and components mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES showing maximum ratings for concrete anchors (tests or calculations).

C. Coordination Drawings: Show coordination of seismic and/or wind load bracing for Plumbing and Fire Protection piping and equipment with other systems and equipment in the vicinity, including other supports and seismic and/or wind restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Field quality-control inspection reports.

G. Provide certification for testing or experience data for specific Division 23 equipment (refer to individual specification sections) per ASCE-7.

1.6 QUALITY ASSURANCE

A. Comply with seismic and wind restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Restraint devices shall have horizontal and vertical load analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum restraint ratings. Submittals based on independent testing and/or calculations are acceptable. Calculations (including combining shear and tensile loads) to support restraint designs must be signed and sealed by a qualified professional engineer.

D. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements of this section, provide products by Kinetics Noise Control or equivalent.

B. Provide appropriate product(s) from those listed below to meet the requirements of restraining or restraining/vibration isolating Plumbing and Fire Protection components.

2.2 COMBINATION RESTRAINT/VIBRATION ISOLATION DEVICES FOR NON-CURB MOUNTED EQUIPMENT

A. Restrained Rubber/Neoprene Mounts, Model RQ: All-directional restrained mountings.

1. Materials: Cast-ductile-iron or welded steel housing containing oil-

resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

B. Restrained Spring Isolators, Model FHS: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

5. Housing: Factory drilled for bolting to structure

C. Restrained Spring Isolators, Models FLS / FLSS: Freestanding, steel, open-spring isolators with limit-stop/restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

D. Side Mount Restrained Spring Isolator, Model FMS: Side mount spring isolator with integral restraint snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional restraint.

2. Base: Factory drilled for bolting to structure.

3. Equipment Mount: Factory drilled for bolting to the equipment.

4. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

5. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

2.3 COMBINATION RESTRAINT/VIBRATION ISOLATION DEVICES FOR CURB MOUNTED EQUIPMENT

A. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb and rail designed to resiliently support equipment and to withstand seismic and wind forces.

1. All of the components within the final product and including the final product are to be manufactured within the United States of America.

2. Complete curb and isolation assembly shall be stamped by a Professional Engineer licensed in the jurisdiction of the project.

3. Provide sloped and/or extended height curb assemblies as necessary to coordinate with roof slope and buildup.

B. Sheet Metal Restraint/Spring Isolation Curbs, Model KSCR: Upper frame shall consist of extruded aluminum top rail, shall provide continuous support for equipment, and shall be captive to resiliently resist seismic and wind forces. Lower support assembly to be constructed out of formed heavy gage sheet metal, shall have a means for attaching to building structure, contain a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches (50 mm) of rigid, glass-fiber insulation on inside of assembly.

C. Structural Steel Restraint/Spring Isolation Curbs, Model ESR: Upper frame shall consist of a structural steel C channel to provide continuous support for the equipment and provide a place of attachment to the equipment. The lower frame shall be constructed from structural steel and shall provide adequate support to resist seismic and wind loads. The springs shall be adjustable, restrained with 1/4-inch (6-mm) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators

with seismic/wind restraint.

a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.

b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

c. Minimum Additional Travel: 50 percent of the required deflection at rated load.

d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

e. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

a. Resilient Material: Oil- and water-resistant hermetically sealed compressed fiberglass.

3. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

4. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

5. Extend height of curb as necessary to allow for spring isolator access after roof buildup is installed.

2.4 FLEXIBLE CONNECTORS TO ACCOMMODATE DIFFERENTIAL MOTION

A. Basis-of-Design Product: Subject to compliance with requirements of this section, provide flexible connectors to accommodate differential motion by Engineered Flexible Products (EFP) or equivalent.

B. General Requirements for Flexible Connectors to Accommodate Differential Motion:

1. Flexible connectors shall be chosen to accommodate differential motion caused where piping crosses seismic joints, where adjacent sections or branches are supported by different structural elements,

and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

2. Flexible connectors shall not introduce any thrust loads into the distribution system and shall contain a welded on braid.

3. Flexible connectors shall be constructed of stainless steel braid with carbon steel end fittings and/or bronze braid with copper end fittings.

4. Flexible connectors shall be V-shaped and capable of accommodating up to 4 inches (100 mm) of differential motion from centerline.

5. Flexible connectors shall be supplied by restraint supplier as part of restraint system.

2.5 SEISMIC AND WIND RESTRAINT DEVICES

A. General Requirements for Concrete Anchoring Components:

1. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

2. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be per IBC.

B. Snubbers, Model KSMS / KSMG: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismically rated, with an ICC-ES report.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

C. Cable Restraint Kit, Model KSCU, KSWC, or KSCC: A pair of pre-stretched steel cables with end connections made of steel assemblies with thimbles (if vibration isolation is needed), brackets, swivels, and bolts designed for restraining cable service.

1. Kit shall include all hardware required for connection to the

equipment/system.

2. Kit shall include a tool-less connector to avoid cable cutting and saddle clamps where possible.

3. Cables shall have one end pre-swaged from the manufacturer.

4. Cable size shall be 2 mm, 3 mm, 5 mm, and/or 6 mm in diameter depending on calculated design load.

5. Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.

D. Hanger Rod Stiffener, Model KHRC: Clamp for attaching reinforcing steel angle to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

G. Resilient Isolation Washers and Bushings, Model TG: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts, Model KCAB/KCCAB/KUAB: Select anchor bolts with strength required for anchorage and as tested according to ASTM E 488. Minimum length of anchor to be eight times diameter.

1. Anchor bolts to be zinc-coated steel for interior applications and stainless steel for exterior applications.

2. For equipment that is rigidly mounted and has 10 horsepower or less use drilled-in and stud-wedge or female-wedge type anchor.

3. For equipment that is rigidly mounted and has greater than 10 horsepower, use undercut anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved by Professional Engineer of record for the project.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on delegated design drawings to receive them and where required to prevent buckling of hanger rods due to seismic and/or wind load forces.

C. Strength of Support and Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic and/or wind loads within specified loading limits.

3.3 SEISMIC AND WIND RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in architectural specifications for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install restraint snubbers on equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Combination restraint/vibration isolation devices may be installed

in lieu of separate vibration isolators and restraint snubbers if they conform to all requirements of this specification and Division-22 Section, Vibration Isolation for Plumbing Piping and Equipment.

3. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

4. Install restraint devices using methods provided by restraint supplier and required submittals for component.

C. Piping Restraints:

1. Comply with requirements of restraint system manufacturer.

D. Piping Riser Restraints:

1. Comply with requirements in SMACNA.

2. Restrain per sections 3.03.A and 3.03.B.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install restraint devices using methods approved by the restraint supplier required by the submittals for the component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges/webs of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

B. Flexible connections to be supplied by restraint supplier.

3.5 FIELD QUALITY CONTROL

A. Inspections:

1. Verify isolator restraint clearance.

2. Verify snubber minimum clearances.

3. Verify ten percent of all cable restraints to ensure the angle of the restraints is installed properly.

4. Verify ten percent of all hanger rod locations where hanger rod stiffening is indicated in coordination drawings to ensure hanger rod stiffeners are installed properly.

3.6 ADJUSTING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

B. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 SEISMIC-RESTRAINT DEVICE SCHEDULE

A. See chart below for component importance factor.

ITEM	IMPORTANCE FACTOR
PUMPS – INLINE	1.5
EXPANSION TANKS	1.5
GENERATORS	1.5
DOMESTIC BOOSTER PUMPS	1.5
FIRE PUMPS	1.5

END OF SECTION

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of plumbing identification work required by this section is indicated on drawings and/or specified in other Division-22 sections.

B. Types of identification devices specified in this section include the following:

1. Pipe Markers
2. Painted Identification Materials
3. Underground-Type Plastic Line Marker
4. Valve Tags
5. Valve Schedule Frames
6. Engraved Plastic-Laminate Signs
7. Plastic Equipment Markers
8. Plasticized Tags

C. Plumbing identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division-22 sections.

D. Refer to other Division-22 sections for identification requirements at central-station mechanical control center; not work of this section.

E. Refer to Division-26 sections for identification requirements of electrical work; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 or Owner standards for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" (213 mm X 275 mm) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.

C. Maintenance Data: Include product data and schedules in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers' products which may be incorporated in the work include the following:

1. Brady

2. Seton

3. Bunting

2.2 PLUMBING IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-22 sections. Where more than single type is specified for application,

selection is Installer's option but provide single selection for each product category.

2.3 PIPE MARKERS

A. Snap-on Type: Provide pre-printed, semi-rigid, snap-on color coded identification sleeves complying with ANSI A13.1. This type shall be used for insulated pipe sizes 2" and smaller.

B. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive, vinyl markers conforming to ANSI A13.1. This style marker shall be applied to all uninsulated piping; insulated piping 2-1/2" and larger.

C. Flow Direction: Provide flow directional arrows either as part of markers, or separately attached to pipes.

2.4 PAINTED IDENTIFICATION MATERIALS

A. Piping and Equipment Systems: Continuous color coded painting of piping and equipment shall be provided in all mechanical rooms in compliance with ANSI A13.1.

2.5 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" (150 mm) wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

1. Provide multi-ply tape consisting of solid aluminum foil core between two layers of plastic tape.

2.6 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage (1.2 mm) polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" (6 mm) high letters and sequenced valve numbers 1/2" (13 mm) high, and with 5/32" (4 mm) hole for fastener.

1. Provide 1-1/2" (40 mm) diameter tags, except as otherwise indicated.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain

(wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.7 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with lexan.

1. Locate one schedule where directed. Provide second schedule to Owner framed in rigid plastic frame with rigid plastic glazing.

2.8 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: 1/16" (1.6 mm) for units up to 20 sq. in. (12900 mm2) or 8" (200 mm) length; 1/8" for larger units.

B. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

C. Duty: Accident-prevention tags with appropriate wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.9 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and schedule number

2. Equipment service

2.10 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in plumbing identification work with corresponding designations shown on plans. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.

B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) exterior non-concealed, locations, and concealed gas piping.

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

4. At access doors, manholes and similar access points which permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced intermediately at maximum spacing of 25 feet (7500 mm)

along each piping run.

a. Space fire main and fire sprinkler main markers at intervals not exceeding 10' (3 m) on straight pipe runs unless pipe is painted red throughout.

C. Gas Pipe: Paint exposed gas pipe throughout (except chromium plated).

3.3 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" (150 to 200 mm) below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16" (400 mm), install single line marker.

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, shut-off valves at plumbing fixtures, and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Comply with requirements of "Valve Schedule" of this section.

2. Fire protection valves (shutoff, test, drain, etc. shall be labeled with a rigid plastic identification sign, secured with corrosion-resistant wire or chain, per NFPA 13.

3.5 PLUMBING EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

2. Fuel-burning units.

3. Pumps, compressors and similar motor driven units.

4. Fire protection valves, as hereinbefore specified.

5. Tanks and pressure vessels.

B. Lettering Size: Minimum 1/4" (6 mm) lettering for name of unit where viewing distance is less than 2'- 0" (600 mm-0 mm), 1/2" (13 mm) high for distances up to 6'- 0" (1800 mm-0 mm), and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

C. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Relocate any plumbing identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each plumbing identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

3.8 IDENTIFICATION SCHEDULE

SERVICE	DESIGNATION
Cold Water	CW
Hot Water	HW
Hot Water Recirculating	HWR
Fire Protection	FIRE
Sprinkler	SPKR

Gas	GAS
Compressed Air (psi) (__ kPa)	AIR
Sanitary Sewer	SAN
Vent	VENT
Storm Water	SW
Air Conditioning Drain	A/C COND
Pumped Discharge	PD

END OF SECTION

SECTION 22 0700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of mechanical insulation required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Piping System Insulation:
    a. Fiberglass
    b. Flexible Elastomeric
2. Equipment Insulation:
    a. Fiberglass
    b. Flexible Elastomeric

C. Refer to all other Division-22 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firms with at least five (5) years successful installation experience on projects with mechanical insulations similar to that required for this project. Provide installer's certification by the manufacturer's training program where applicable.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories, and intended use for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work, shall be limited to the following:

1. Owens Corning
2. Johns Manville
3. Certainteed
4. Armacell
5. Knauf
6. Aeroflex

2.2 PIPE INSULATION MATERIALS

A. Fiberglass Pipe Insulation: ASTM C 547-00, Type 1 (up to 850°F) (up to 454°C), maximum k-value of 0.23 BTU-in/hr-ft2-deg F at a mean temperature of 75°F.

B. Flexible Elastomeric Pipe Insulation: ASTM C 534, Type I (-40°F to 200°F) (-40°C to 93°C), maximum k-value of 0.25 BTU-in/hr-ft²-deg F at a mean temperature of 75°F.

C. Jackets for Piping Insulation: Jacket assembly shall be ASTM C 1136, Type I with vapor retarder (0.02 perms).

1. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.

2. Encase exterior piping insulation with 26 gauge embossed aluminum jacket with weather-proof construction.

D. Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealer, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.3 EQUIPMENT INSULATION MATERIALS

A. Rigid Fiberglass Equipment Insulation: ASTM C 612-00, Type 1A (up to 450°F) (up to 232°C).

B. Flexible Elastomeric Cellular Sheet Insulation: ASTM C 534, Type 2, R-value of 8.0 at 2", (-40°F to 200°F) (-40°C to 93°C).

C. Jacketing Material for Equipment Insulation: Provide 8 ounce (227 g) canvas or pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard (263 g/m2), or metal jacket at Installer's option, except as otherwise indicated

D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Accessories: Provide bands, wire, wire netting, tape corner angles, anchors, stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Only install mechanical insulation on systems while not in operation.

3.2 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), fire protection piping, preinsulated equipment and air conditioning condensate drain piping in mechanical rooms and/or on roof.

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:

a. Potable cold water piping.

b. Interior above-ground horizontal storm water piping and roof drain sumps.

c. Interior above-ground horizontal sanitary piping.

d. Plumbing vents within 6 linear feet (1800 mm) of roof outlet.

e. Make-up water piping.

f. Air conditioning condensate drain piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 1" (25 mm) thickness.

b. Flexible Elastomeric: 1/2" (13 mm) thickness.

C. Hot Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:

a. Potable hot water piping.

b. Potable hot water recirculating piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 1" (25 mm) thick for pipe sizes up to 1" (25 mm). 1-1/2" (40 mm) thick for 1-1/4" (32 mm) and 1-1/2" (40 mm) pipe, and 2" (50 mm) thick for pipe sizes 2" (50 mm) and larger. Note: Insulation provided for domestic hot water applications shall have a minimum R-value of 6.0.

3.3 EQUIPMENT INSULATION

A. Hot Equipment (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot equipment:

a. Hot water storage tanks

b. Metal flue outlet of each water heater

2. Insulate each item of equipment specified above with the following type and thickness of insulation:

a. Flexible Elastomeric: 2" (50 mm) thick, except 3" (75 mm) thick for steam-jacketed heat exchangers.

B. Breeching and Stack Insulation:

1. Application Requirements: Insulate the following breechings and stacks:

a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.

b. Stacks from bottom to top except for factory insulated stacks.

3.4 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

1. Insulation materials shall not be applied until systems have been witnessed, documented, and submitted to meet pressure testing requirements indicated throughout these specifications.

B. Install insulation on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Staples shall not be used.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Provide factory molded insulation or pre-fabricated fittings for all valves, fittings, unions, etc. Valve handles must be extended by the mechanical contractor to accommodate the insulation without reducing the thickness or integrity of the valve insulation.

G. All water test ports shall be accessible from the insulation. In addition, water flow measuring stations require access from insulation to verify sizes and model.

H. Extend piping insulation without interruption through pipe hangers, walls, floors and similar piping penetrations, except where otherwise indicated.

I. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" (75 mm) wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" (75 mm) wide vapor barrier tape or band. If using pipe hangers, follow manufacturer's instructions for installation.

J. All exposed pipe insulation, including fittings, above 8'- 0" (2400 mm-0 mm) of finished floor shall have 8 oz. (227 g) fire retardant canvas cover neatly cut and parted seams shall be sealed.

K. All exposed pipe insulation, including fittings, within 8' - 0" (2400 mm-0 mm) of finished floor or within a stairwell, shall be provided with aluminum or PVC protective covers. All edges shall be hemmed and all seams shall be concealed.

L. All exterior piping shall be provided with an embossed aluminum jacket.

M. For all insulated piping 2-1/2" (63 mm) and larger, provide insulated pipe saddles as follows:

1. For domestic hot and cold water piping (up to 250ºF), provide the following:

a. Minimum 3.75 pcf, non-compressive, rigid, phenolic foam insulation. Fire and smoke rating shall be 25/50 or below per ASTM 84.

b. For cold applications below 75ºF (24ºC) a zero permeability, abuse resistant, vapor barrier shall be provided with matching butt strips. Apply a full coating of butyl joint sealant in addition to the butt strips for a completely sealed system.

c. The phenolic foam system shall have a K factor of 0.16 at a mean temperature for 75ºF (24ºC) and comply with ASTM Standard C1126.

d. Provide visible inspection sticker at the bottom of each saddle.

e. Pipe insulation saddles shall be Tru-Balance CoolDry Saddles as manufactured by Buckaroos, Inc. or equivalent.

f. Armacell Armafix Pipe Hangers may be used for cold water piping with flexible elastomeric insulation.

3.5 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

1. Insulation materials shall not be applied until systems have been witnessed, documented, and submitted to meet pressure testing requirements indicated throughout these specifications.

2. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

3. Maintain integrity of vapor-barrier on equipment insulation and

protect it to prevent puncture and other damage.

4. Do not apply insulation to equipment, breechings, or stacks while equipment is operating.

5. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

6. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

7. If using fiberglass insulation, cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2" (50 mm). Apply over vapor barrier where applicable.

8. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

3.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division-22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping installer for piping insulation application and equipment installer for equipment 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.

3.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

3.8 EXISTING INSULATION REPAIR/REPLACEMENT

A. Repair damaged sections of existing mechanical and plumbing insulation, either previously damaged or damaged during this

construction period. Insulation shall be as specified herein.

B. Provide new insulation on existing mechanical and plumbing piping where existing insulation has been removed due to damage, repair or abatement of existing hazardous materials.

3.9 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of domestic water piping systems work is indicated on drawings and schedules, and by requirements of this section.

B. Applications for domestic water piping systems include the following:

1. Domestic cold-water piping
2. Domestic hot-water piping
3. Domestic recirculating-water piping
4. Exterior water piping
5. Make-up water piping

C. Refer to appropriate Division-22 sections for insulation required in connection with domestic water piping; not work of this section.

D. Refer to appropriate Division-02 sections for trenching and backfill required in conjunction with exterior water piping; not work of this section.

E. Trenching and backfill required in conjunction with domestic water piping inside of building foundations is specified in applicable Division-02 and Division-22 sections, and is included as work of this section.

F. Refer to other Division-22 sections for water treatment, (sterilization) not work of this section.

1.2 QUALITY ASSURANCE

A. Qualification of Installers: The entire system shall be installed by trained workmen skilled in the installation of such systems.

B. Plumbing Code Compliance: Comply with applicable portions of International Plumbing Code and all other applicable codes and/or Owner's requirements pertaining to plumbing materials, construction and installation of products.

C. ANSI and ASTM Compliance: Comply with applicable standards pertaining to products and installation of domestic water piping systems.

D. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

E. NSF Standard 14 Compliance: Plastic Piping components and related materials.

F. Structural Performance: Pipe hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data for domestic water piping systems, materials and products.

B. Shop Drawings: Submit scaled layout drawings as required by Division-22 Section "Basic Plumbing Requirements".

C. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in domestic water piping systems. Where more than one type of materials or products is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-22 Section "Identification for Plumbing Piping and Equipment".

2.3 BASIC PIPE, TUBE, AND FITTINGS

A. General: Provide pipe, tube, and fittings complying with Division-22 Section "Pipe, Tube, and Fittings for Plumbing Systems", in accordance with the following listing:

B. Interior Domestic Hot Water Piping:

1. Tube Size 2" (50 mm) and Smaller: Copper tube.

a. Wall Thickness: Type L, hard-drawn temper.

b. Fittings: Wrought-copper, solder-joints.

2. Pipe Size 2-1/2" (65 mm) and Larger: Copper pipe.

a. Wall Thickness: Type L, hard-drawn temper.

b. Fittings: Wrought-copper, grooved and solder joints.

C. Interior Domestic Cold Water Piping:

1. Tube Size 2" (50 mm) and Smaller: Copper tube.

a. Wall Thickness: Type L, hard-drawn temper.

b. Fittings: Wrought-copper, solder-joints

2. Pipe Size 2-1/2" (65 mm) and Larger: Copper pipe.

a. Wall Thickness: Type L, hard-drawn temper.

b. Fittings: Wrought-copper, grooved and solder joints.

D. Exterior and Below Grade Cold Water Piping:

1. Tube Size 2" (50 mm) and Smaller: Copper tube.

a. Wall Thickness: Type K, soft-annealed temper.

b. Fittings: Wrought-copper, solder-joints.

2. Pipe Size 2-1/2" (65 mm) and Larger: Ductile-iron pipe, with cement-mortar lining.

    a. Pipe Weight: Schedule 150.

    b. Fittings: Ductile-iron, with rubber-gasket joints.

E. Cold Water Piping to Trap Primers: Type M copper tubing.

2.4 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Division-22 Section "Piping Specialties for Plumbing Systems", in accordance with the following listing:

1. Pipe escutcheons
2. Low-pressure Y-type pipeline strainers
3. Dielectric fittings
4. Drip pans
5. Pipe sleeves
6. Sleeve seals

2.5 SPECIAL PIPING SPECIALTIES

A. Water Hammer Arresters: Provide bellows type water hammer arresters, stainless steel casing and bellows, pressure rated for 250 psi (1725 kPa), tested and certified in accordance with PDI Standard WH-201.

B. Hose Connection Vacuum Breakers: Provide hose connection vacuum breakers where indicated for back-siphonage protection.

1. Brass construction, suitable for indoor or outdoor use (maximum pressure 125 psi) (maximum pressure 865 kPa).
2. Inlet shall be 3/4" (20 mm) standard female hose thread; outlets shall be 3/4" (20 mm) male hose thread.
3. Provide non-removable feature to prevent unauthorized removal from pipe system or sill cock.

2.6 BASIC SUPPORTS AND ANCHORS

A. General: Provide supports, anchors, and seals complying with Division-22 Section "Hangers and Supports for Plumbing Piping and Equipment", in accordance with the following listing:

1. Adjustable steel clevises, adjustable roller hangers, and adjustable pipe roll stands for horizontal piping hangers and supports.

2. Two-bolt riser clamps for vertical piping supports.

3. Concrete inserts, C-clamps, and steel brackets for building attachments.

4. Protection saddles for insulated piping support in hangers.

5. Copper flashings for piping penetrations.

2.7 BASIC VALVES

A. General: Provide valves complying with Division-22 Section "Valves for Plumbing Piping", in accordance with the following listing:

1. Sectional Valves:

   a. 2" (50 mm) and Smaller: Ball Valves.

   b. 2-1/2" (65 mm) and Larger: Butterfly Valves.

2. Shutoff Valves:

   a. 2" (50 mm) and Smaller: Ball Valves.

   b. 2-1/2" (65 mm) and Larger: Butterfly Valves.

3. Drain Valves:

   a. 2" (50 mm) and Smaller: Ball Valves.

4. Incoming Water Service:

   a. All Sizes: OS&Y Gate Valves.

5. Check Valves:

a. All Sizes: Swing Check Valves.

2.8 SPECIAL VALVES

A. General: Special valves required for domestic water piping systems include the following types:

1. Balance Cocks:

a. Soldered Ends 2" (50 mm) and Smaller: Class 125, bronze body, bronze plug, screw driver operated, straight or angle pattern.

2. Hose Bibb:

a. Soldered End: Bronze body, renewable composition disc, wheel handle, 3/4" (20 mm) solder inlet, 3/4" (20 mm) hose outlet with integral vacuum breaker.

3. Hydrants:

a. Recessed Non-Freeze Wall Hydrants: Cast-bronze box hydrant, polished bronze face plate, tee handle key, bronze casing, length to suit wall thickness, vacuum breaker, hinged locking cover, 3/4" (20 mm) inlet, hose outlet.

2.9 PUMPS

A. General: Provide pumps complying with Division-22 Section "Plumbing Pumps", in accordance with the following listing:

1. Hot water recirculating

2. Water pressure booster

2.10 BACKFLOW PREVENTERS (DOMESTIC WATER AND MAKE-UP WATER)

A. General: Provide reduced pressure principle backflow preventers consisting of assembly including shutoff valves on inlet and outlet, and strainer on inlet. Backflow preventers shall include test cocks, and pressure-differential relief valve located between two (2) positive seating check valves. Construct in accordance with ASSE Standard 1013.

B. Backflow preventer size shall not be less than the connected line size indicated.

2.11 PRESSURE REGULATING VALVES

A. General: Provide pressure regulating valves, single seated, direct operated type, bronze body, integral strainer, complying with requirements of ANSI/ASSE Standard 1003. Size for maximum flow rate and inlet and outlet pressures indicated on drawings.

2.12 BASIC EXPANSION COMPENSATION

A. General: Provide expansion compensation products complying with Division-22 Section "Expansion Compensation for Plumbing Piping", in accordance with the following listing:

1. Expansion compensators for hot water and hot water recirculating piping.

2. Pipe alignment guides.

2.13 BASIC METERS AND GAUGES

A. General: Provide meters and gauges complying with Division-22 Section "Meters and Gauges for Plumbing Piping".

PART 3 - EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division-22 Section "Identification for Plumbing Piping and Equipment".

3.2 INSTALLATION OF DOMESTIC WATER DISTRIBUTION PIPING

A. General: Install water distribution piping in accordance with Division-22 Section "Pipe, Tube, and Fittings for Plumbing Systems".

B. Domestic cold water tubing serving trap primers located below floor slab shall be installed in 2" (50 mm) PVC conduit.

3.3 INSTALLATION OF EXTERIOR WATER PIPING

A. General: Install exterior water service piping system in compliance with local governing regulations.

B. Water Service Piping: Extend water service piping of size and in location indicated to water service entrance at building. Provide sleeve in foundation wall for water service entry; make entry watertight. Provide gate valve at water service entry inside building; strainer, pressure gage, test tee with valve.

C. Copper Tube: Install in accordance with recommended procedures of the Copper Development Association.

D. Ductile-Iron Pipe: Install in accordance with ANSI/AWWA C-60.

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Division-22 Section "Piping Specialties for Plumbing Systems".

B. Water Hammer Arresters: Install in upright position, in locations and of sizes in accordance with PDI Standard WH-201, and elsewhere as indicated.

3.5 INSTALLATION OF SUPPORTS, ANCHORS, AND SEALS

A. Install supports, anchors, and seals in accordance with Division-22 Section "Hangers and Supports for Plumbing Piping and Equipment".

3.6 INSTALLATION OF VALVES

A. Install valves in accordance with Division-22 Section "Valves for Plumbing Piping".

B. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two (2) or more plumbing fixtures or equipment connections, and elsewhere as indicated.

C. Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.

D. Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain domestic water piping system.

E. Check Valves: Install on discharge side of each pump, and elsewhere as indicated.

F. Balance Cocks: Install in each hot water recirculating loop, and

elsewhere as indicated.

G. Hose Bibbs: Install where indicated, with vacuum breaker.

H. Hydrants: Installed where indicated, in accordance with manufacturer's installation instructions.

3.7 INSTALLATION OF PUMPS

A. Install pumps in accordance with Division-22 Section "Plumbing Pumps".

B. Refer to automatic temperature control section for control of hot water recirculating pumps; not work of this section.

C. Provide the following controls for each hot water recirculating pump and provide interface to the building automation system. Refer to Automatic Temperature Control Section; not work of this section.

1. Immersion aquastat to start pump at 110°F (43°C) and stop pump at 120°F (49°C).

2. Seven (7) day time clock and separate on-auto-off switch or interface with BAS scheduling.

3. All relays required for above.

3.8 INSTALLATION OF BACKFLOW PREVENTERS

A. Install backflow preventers where indicated, and where required by International Plumbing Code. Pipe relief outlet to nearest floor drain thru air gap fitting.

3.9 INSTALLATION OF PRESSURE REGULATING VALVES

A. Install pressure regulating valves where required to reduce the pressure below the code allowable pressure. Provide inlet and outlet shutoff valves, and globe valve bypass. Provide pressure gage on valve inlet outlet.

3.10 INSTALLATION OF EXPANSION COMPENSATION PRODUCTS

A. Install expansion compensation products in accordance with Division-22 Section "Expansion Compensation for Plumbing Piping".

3.11 INSTALLATION OF METERS AND GAUGES

A. Install meters and gauges in accordance with Division-22 Section "Meters and Gauges for Plumbing Piping".

3.12 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts of sizes indicated, but in no case smaller than required by International Plumbing Code.

B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated, and comply with equipment manufacturer's installation instructions. Provide shutoff valve and union for each connection, provide drain valve on drain connection.

3.13 SPARE PARTS

A. Furnish to the Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

END OF SECTION

SECTION 22 1123 - PLUMBING PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of plumbing pumps work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of pumps specified in this section include the following:

1. In-Line Recirculation Pumps
2. Water Pressure Booster Systems
3. Gas Booster Systems (TBD)

C. Refer to other Division-22 sections for insulation of pump housings; not work of this section.

D. Refer to other Division-22 sections for vibration control of plumbing pumps; not work of this section.

E. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:

1. Control wiring between field-installed controls, indicating devices, and pump control panels.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. HI Compliance: Design, manufacture, and install plumbing pumps in accordance with HI "Hydraulic Institute Standards".
2. UL Compliance: Design, manufacture, and install plumbing pumps in accordance with UL 778 "Motor Operated Water Pumps".
3. UL and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA standards.

4. SSPMA Compliance: Test and rate sump and sewage pumps in accordance with Sump and Sewage Pump Manufacturer's Association (SSPMA) and provide certified rating seal.

5. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

6. Department of Energy (DOE) compliance: Pump manufacturer shall comply with US Department of Energy (DOE) energy conservation standard for "clean water pumps" 1-200 horsepower, less than 459 feet of head and greater than 25 gpm. These pumps shall be evaluated using the Pump Energy Index (PEI) of equal to or lesser than 1.0. The PEI number shall appear on the pump name plate and be available for the record at http://er.pumps.org.

7. ASCE-7: Minimum Design Loads for Buildings and Other Structures.

B. Certification, Pump Performance: Provide pumps whose performances, under specified operating conditions, are certified by manufacturer.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to plumbing pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and spare parts lists for each type of pump, control, and accessory; including "troubleshooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual.

E. Manufacturer Seismic Qualification Certification: Submit certification that the pumps and accessories will withstand seismic forces as defined in

ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

    b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle plumbing pumps and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged plumbing pumps or components; replace with new.

B. Store plumbing pumps and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading plumbing pumps, and moving them to final location.

PART 2 - PRODUCTS

2.1 PUMPS

A. General: Provide factory-tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump are listed in pump schedule. Provide pumps of same type by same manufacturer.

2.2 IN-LINE RECIRCULATION PUMPS

A. General: Provide in-line recirculation pumps where indicated, and of capacities as scheduled.

B. Type: Horizontal, oil-lubricated, designed for 125 psi (850 kPa) working pressure, 225°F (107°C) continuous water temperature, and specifically designed for quiet operation.

C. Body: All bronze construction.

D. Shaft: Stainless steel, ground and polished, integral thrust collar.

E. Bearings: Two horizontal sleeve bearings designed to circulate oil.

F. Seal: Mechanical, with carbon seal face rotating against ceramic seat.

G. Motor: Non-overloading at any point on pump curve, open, dripproof, sleeve bearings, quiet operating, rubber mounted construction, built-in thermal overload protection.

H. Coupling: One-piece spring coupling.

2.3 WATER PRESSURE BOOSTER SYSTEM

A. General: Provide factory-fabricated and tested water pressure booster system consisting of diaphragm type water tank, centrifugal pumps, power and control panels, instrumentation, and operating controls. Provide size as indicated, capacities as scheduled.

B. Pumps: Provide two (2) variable speed, single stage, end-suction design, cast iron, bronze fitted centrifugal pumps with mechanical shaft seals. Mount pumps on vibration isolators. Provide temperature probe and electric purge valve immediately upstream of each pressure reducing valve. Provide drip-proof motors.

C. System Controls: Maintain system pressure with pilot-operated diagram type combination pressure regulating and non-slam check valve on each pump discharge line.

1. Provide low system pressure switch located on discharge header to sense drop in system pressure, and to activate alarm and automatically start standby pump.

2. Provide adjustable vane type flow switch to switch to sequence lag pump.

D. Control Panel: Provide UL-listed, NEMA 1, hinged door, lockable control panel containing the following:

1. For Each Pump:

a. Fused disconnect switch

b. Motor starter with 3-leg overload protection

c. Running light

d. Multiple position motor control switch

e. Discharge pressure gage

2. For System:

a. 115V control transformer

b. Control power switch

c. Indicating lights

d. Relays

e. Visual alarm system

f. Suction pressure gage

E. Prefabrication: Factory-prefabricate booster system, mount all components on common structural stand. Provide interconnecting piping, isolation valves on suction and discharge of each pump, suction and discharge piping manifolds, shutoff cocks for gages and pressure switches, and factory-wiring.

F. Factory-Test: Provide electrical and hydraulic test on assembled unit prior to shipment. Provide system operating flow test from 0 to 100% design flow

rate at scheduled suction and discharge pressure conditions.

2.4 PACKAGED GAS BOOSTER SYSTEMS (TBD)

A. General: The packaged gas booster system shall be a complete assembled unit designed to deliver the specified gas at ambient temperatures at a relatively constant added pressure over the specified volume flow. The system shall include, but not be limited to an appropriately sized gas booster blower of the hermetically sealed centrifugal type, check valve, gas pressure switch, isolating valves, inlet and outlet piping and flange connectors, pressure gauges and control system all mounted, assembled, wired and tested. The booster blower shall be UL listed as a unit assembly including the blower motor.

B. Check Valves: Check valves shall be of the swing disk type constructed of heavy-duty cast iron with a lightweight aluminum disk and removable top with gasket for ease of inspection and service. Valves shall be designed to withstand a back-pressure differential of a minimum of 7 psig across the valve seat and all sizes shall require no more than 1.5 inches w.c. forward-pressure differential to open. Valves sized up to and including 3 inches shall be screwed connection. Sizes 4 inches and larger shall be flanged. Check valves shall be FM approved and shall be Eclipse Series 1000 or equivalent.

C. Control System: The control system shall be a complete unit factory built to provide safe, proper automatic operation of the gas booster blower system. The control system shall be a standard cataloged item that has been particularly designed for the booster system. The enclosure shall be rated for the environmental conditions and have UL and CSA listing. Internal panel components shall include, but not be limited to a door interlocked disconnect with provision for padlocking, motor starter sized according to NEMA standards or at least one size larger that IEC standards, properly sized motor overload and short-circuit protection, indicating lights with a rated life of at least 20,000 hours, DIN-rail mounted terminals and numbered wiring.

D. Gas booster system shall be as manufactured by Eclipse or equivalent.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which plumbing pumps are to be installed. Do not proceed with work until unsatisfactory conditions have

been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PUMPS

A. General: Install plumbing pumps where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that plumbing pumps comply with requirements and serve intended purposes.

B. Access: Provide access space around plumbing pumps for service as indicated, but in no case less than that recommended by manufacturer.

C. Support: Refer to Division-22 section "Vibration Control for Plumbing Piping and Equipment" for support and mounting requirements of plumbing pumps.

1. Install in-line pumps, supported from piping system.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

E. Piping Connections: Refer to Division-22 plumbing piping sections. Provide piping, valves, accessories, gages, supports, and flexible connections as indicated.

3.3 ADJUSTING AND CLEANING

A. Alignment: Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.

B. Start-up: Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 22 1316 - SOIL, WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of soil and waste piping system work is indicated on drawings and schedules, and by requirements of this section.

B. Applications for soil and waste piping systems include the following:

1. Aboveground soil, waste and vent piping within buildings including soil stacks, vent stacks, horizontal branches, traps, and connections to fixtures and drains.

2. Underground building drain piping including mains, branches, traps, connections to fixtures and drains, and connections to stacks, terminating at connection to sanitary sewers five feet outside of foundation wall.

C. Exterior sanitary sewer system is specified in applicable Division-02 sections, and is included as work of this section.

D. Refer to appropriate Division-22 sections for insulation required in connection with soil and waste piping; not work of this section.

E. Trenching and backfilling required in conjunction with underground building drain piping is specified in applicable Division-22 sections, and is included as work of this section.

1.2 QUALITY ASSURANCE

A. Specimen Joints: Before commencing pipe laying, Contractor shall form specimen joints to demonstrate that materials and methods employed will result in watertight joints.

B. Qualification of Installers: The entire system shall be installed by trained workmen skilled in the installation of such systems for a minimum of five (5) years.

C. Plumbing Code Compliance: Comply with applicable portions of International Plumbing Code pertaining to plumbing materials, construction and installation of products.

D. ANSI Compliance: Comply with applicable American National Standards pertaining to products and installation of soil and waste piping systems.

E. PDI Compliance: Comply with applicable Plumbing and Drainage Institute Standards pertaining to products and installation of soil and waste piping systems.

F. Structural Performance: Pipe hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data for soil and waste piping systems materials and products.

B. Shop Drawings: Submit scaled layout drawings of soil and waste pipe and fittings showing interface and spatial relationship between piping, ductwork and proximate equipment.

C. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cleanouts, drains and valves which may be incorporated in the Work include the following:

1. Josam
2. J. R. Smith
3. Zurn
4. Mifab
5. Wade

6. Watts Drainage

2.2 SOIL, WASTE AND VENT PIPING MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in soil and waste piping systems. Where more than one (1) type of materials or products is indicated, selection is Installer's option.

2.3 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-22 section, "Identification for Plumbing Piping and Equipment".

2.4 BASIC PIPE, TUBE, AND FITTINGS

A. General: Provide pipe, tube, and fittings complying with Division-22 section "Pipe, Tube, and Fittings for Plumbing Systems", in accordance with the following listing:

B. Above Ground Piping Within Buildings:

1. Tube Size 8" (200 mm) and Smaller: Copper tube.

    a. Wall Thickness: Type DWV.

    b. Fittings: Cast-bronze, drainage pattern, solder-joint.

2. Pipe Size 15" (400 mm) and Smaller: Cast-iron hub-and-spigot soil pipe.

    a. Pipe and fittings to be service weight and shall comply with ASTM A 74 and bear the collective mark of the Cast Iron Soil Pipe Institute (CISPI).

    b. Fittings: Compression gasket joints meeting the requirements of ASTM C-564, or lead and oakum joints.

3. Pipe Size 15" (400 mm) and Smaller: Hubless cast-iron soil pipe.

a. Pipe and fittings shall comply with CISPI 301 and bear the collective mark of the Cast Iron Soil Pipe Institute (CISPI).

b. Fittings: Hubless couplings shall comply with CISPI Standard 310.

c. For buildings less than ten (10) floors in height, provide heavy duty shielded couplings for all aboveground piping up to the second floor level.

d. For buildings more than ten (10), but less than twenty (20) floors in height, provide heavy duty shielded couplings for all aboveground piping up to the fourth floor level.

e. Provide heavy duty shielded couplings for all aboveground piping.

f. Heavy Duty Shielded Couplings: Heavy duty couplings shall meet the requirements of ASTM C 1540 and gaskets shall meet the requirements of ASTM 564.

g. Available Manufacturers: Subject to compliance with requirements, manufacturers offering couplings which may be incorporated in the Work include the following:

1) Anaco/Husky

2) Mission Rubber

3) Tyler Coupling

4) Ideal

C. Underground Building Drain Piping:

1. Pipe Size 15" (400 mm) and Smaller: Cast-iron hub and spigot soil pipe.

a. Pipe and fittings to be service weight and shall comply with ASTM A 74 and bear the collective mark of the Cast Iron Soil Pipe Institute (CISPI).

b. Fittings: Compression gasket joints meeting the requirements of ASTM C 564, or lead and oakum joints.

2.5 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Division-22 section

"Piping Specialties for Plumbing Systems", in accordance with the following listing:

1. Pipe Escutcheons
2. Vandal-Proof Vent Caps
3. Pipe Sleeves
4. Sleeve Seals

2.6 SPECIAL PIPING SPECIALTIES

A. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.

B. Vent Flashing Sleeves: Cast-iron caulking type roof coupling for cast-iron stacks, cast-iron threaded type roof coupling for steel stacks.

2.7 SUPPORTS AND ANCHORS

A. General: Provide supports and anchors complying with Division-22 sections in accordance with the following listing:

1. Adjustable steel clevises, steel pipe clamps, and pipe saddle supports for horizontal piping hangers and supports.
2. Two-bolt riser clamps for vertical piping supports.
3. Concrete inserts, C-clamps, and steel brackets for building attachments.
4. Copper flashings for piping penetrations.

2.8 SPECIAL VALVES

A. General: Special valves required for soil and waste piping systems include the following types:

1. Backwater Valves: Cast-iron body, bronze backwater valve assembly swing check type, with cleanout access cover. Provide ends to suit piping material; bolted cover.

2.9 SPECIAL EXPANSION COMPENSATION

A. General: Special expansion compensation products required for soil and waste piping systems include the following types:

1. Expansion Joints: Cast-iron body, adjustable bronze sleeve, bronze bolts with wing nuts; for vertical installation only.

2.10 CLEANOUTS

A. General: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations.

B. Cleanouts in Piping: Cast-iron cleanout ferrule with bronze countersunk plug, suitable for no-hub applications.

C. Cleanouts in finished walls and partitions shall be similar to cleanouts in piping. Provide round polished stainless steel wall access cover with screw. Finish as per Architect.

D. Cleanouts in Tiled Floor: Cast-iron internal gasketed cleanout plug and adjustable housing with secured scoriated square satin Nickel Alloy top.

E. Cleanouts in Non-Tiled Floor: Similar to tiled floor type with a secured scoriated round satin Nickel Alloy top.

2.11 FLOOR DRAINS

A. General: Provide floor drains of size as indicated on drawings; and type, including features, as specified herein:

B. Toilet Room Floor Drain: Cast-iron body and flashing collar, Nickel Alloy adjustable strainer head with secured square grate, with the following features:

1. Heel-proof grate.

2. Bottom outlet, no-hub for aboveground piping or, bottom outlet, hub and spigot for underground piping.

C. Mechanical Room Floor Drain: Cast-iron body and flashing collar, heavy duty loose set grate (minimum 9" diameter) (minimum 225 mm diameter), with the following features:

1. Double drainage flange with weep holes.
2. Sediment bucket.
3. Adjustable extension.
4. Flat bottom strainer.
5. Deep body.
6. Bottom outlet, no-hub for aboveground piping or, bottom outlet, hub and spigot for underground piping.
7. Provide funnels for drains receiving A/C condensate or elsewhere as indicated.

D. General Purpose Floor Drain: Cast-iron body and flashing collar, Nickel Alloy adjustable strainer head with secured square grate, with the following features:

1. Sediment bucket.
2. Heel-proof grate.
3. Bottom outlet, no-hub for aboveground piping or, bottom outlet hub and spigot for underground piping.

E. Cast-Iron Trench Drains: Cast-iron shallow hub body and loose set cast-iron grate 12" (300 mm) wide grate, assembled in standard lengths for total length as indicated, with the following features:

1. Sediment bucket.
2. Flashing device.
3. Vandal-proof grate.
4. Bottom outlet, no-hub for aboveground piping or, bottom outlet, hub and spigot for underground piping.

PART 3 - EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division-22 section "Identification for Plumbing Piping and Equipment".

3.2 INSTALLATION OF SOIL AND WASTE ABOVE GROUND PIPING

A. General: Install soil and waste piping in accordance with Division-22 section "Pipe, Tube, and Fittings for Plumbing Systems", and with International Plumbing Code.

3.3 INSTALLATION OF BUILDING DRAIN PIPING

A. General: Install underground building drains as indicated and in accordance with International Plumbing Code. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Temporarily cover end of uncompleted piping at end of day or whenever work stops.

1. Install soil and vent piping pitched to drain at minimum slope of 1/8" per foot (10 mm per meter) (1%). Where possible 1/4" per foot (20 mm per meter) (2%) shall be provided.

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Division-22 section "Piping Specialties for Plumbing Systems".

3.5 INSTALLATION OF SUPPORTS AND ANCHORS

A. Install supports and anchors in accordance with Division-22 section "Hangers and Supports for Plumbing Piping and Equipment".

3.6 INSTALLATION OF SPECIAL VALVES

A. Backwater Valves: Install in sanitary building drain piping serving fixtures located below curb line and as required by International Plumbing Code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover, and of adequate size to remove valve cover for service. Install in such a manner to provide maximum 1/4" (6 mm) clearance between flapper and seat for air circulation.

3.7 INSTALLATION OF SPECIAL EXPANSION COMPENSATION PRODUCTS

A. Expansion Joints: Install expansion joints on vertical risers as indicated, or as required by International Plumbing Code.

3.8 INSTALLATION OF DRAINAGE PIPING PRODUCTS

A. Cleanouts: Install in sanitary above ground piping and sanitary building drain piping as indicated, as required by International Plumbing Code; and at each change in direction of piping greater than 45 degrees; at minimum intervals of 50 feet (15 m) for piping 4" (100 mm) and smaller and 75 feet (23 m) for larger piping; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

B. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

C. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

3.9 INSTALLATION OF FLOOR DRAINS

A. General: Install floor drains in accordance with manufacturer's written instructions and in locations indicated.

1. Coordinate with soil and waste piping as necessary to interface floor drains with drainage piping systems.

2. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

3. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

4. Position drains so that they are accessible and easy to maintain.

5. Provide trap seal devices as indicated on drawings.

3.10 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide soil and waste piping runouts to

plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by International Plumbing Code.

1. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.11 PIPING TESTS

A. Test soil and waste piping system in accordance with requirements of Division-22 section "Pipe, Tube and Fittings for Plumbing Systems".

END OF SECTION

SECTION 22 1413 - STORM WATER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of storm water piping work is indicated on drawings and schedules, and by requirements of this section.

B. Applications for storm water piping include the following:

1. Conductor piping from roof drains and deck drains to storm water system.

2. Storm water piping from conductor piping and area drains to storm sewers five feet outside of foundation wall.

3. Air conditioning condensate piping.

C. Exterior storm water piping is specified in applicable Division-2 sections, and is included as work of this section.

D. Refer to appropriate Division-22 sections for insulation required in conjunction with storm water piping; not work of this section.

E. Trenching and backfill required in conjunction with storm building drain piping is specified in applicable Division-22 sections, and is included as work of this section.

1.2 QUALITY ASSURANCE

A. Specimen Joints: Before commencing pipe laying, Contractor shall form specimen joints to demonstrate that materials and methods employed will result in watertight joints.

B. Qualification of Installers: The entire system shall be installed by trained workmen skilled in the installation of such systems for a minimum of five (5) years.

C. Plumbing Code Compliance: Comply with applicable portions of International Plumbing Code pertaining to plumbing materials, construction and installation of products.

D. ANSI Compliance: Comply with applicable American National Standards

pertaining to products and installation of soil, waste and storm water piping systems.

E. Structural Performance: Pipe hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data for storm water piping systems materials and products.

B. Shop Drawings: Submit scaled layout drawings of installed storm water pipe and fittings showing interface and spatial relationship between piping and proximate equipment.

C. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cleanouts, drains and valves which may be incorporated in the Work include the following:

1. Josam
2. J. R. Smith
3. Zurn
4. Wade
5. Mifab
6. Watts Drainage

2.2 STORM WATER PIPING MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products

of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in storm water piping systems. Where more than one type of materials or products is indicated, selection is Installer's option.

2.3 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-22 Section "Identification for Plumbing Piping and Equipment".

2.4 BASIC PIPE, TUBE AND FITTINGS

A. General: Provide pipe, tube, and fittings complying with Division-22 Section "Pipe, Tube, and Fittings for Plumbing Systems", in accordance with the following listing:

B. Above Ground Piping Within Buildings:

1. Tube Size 8" (200 mm) and Smaller: Copper tube.

    a. Wall Thickness: Type DWV.

    b. Fittings: Cast-bronze, drainage pattern, solder-joints.

2. Pipe Size 15" (400 mm) and Smaller: Cast-iron hub-and-spigot soil pipe.

    a. Pipe and fittings to be service weight and shall comply with ASTM A-74 and bear the collective mark of the Cast Iron Soil Pipe Institute (CISPI).

    b. Fittings: Compression gasket joints meeting the requirements of ASTM C 564, or lead and oakum joints.

3. Pipe Size 15" (400 mm) and Smaller: Hubless cast-iron soil pipe.

    a. Pipe and fittings shall comply with CISPI 301 and bear the collective mark of the Cast Iron Soil Pipe Institute (CISPI).

    b. Fittings: Hubless couplings shall comply with CISPI Standard 310.

    c. For buildings less than ten (10) floors in height, provide heavy duty shielded couplings for all aboveground piping up to the second floor level.

d. Heavy Duty Shielded Couplings: Heavy duty couplings shall meet the requirements of ASTM C 1540 and gaskets shall meet the requirements of ASTM 564.

e. Available Manufacturers: Subject to compliance with requirements, manufacturers offering couplings which may be incorporated in the Work include the following:

1) Anaco/Husky

2) Mission Rubber

3) Tyler Coupling

4) Ideal

C. Underground Drain Piping:

1. Pipe Size 15" (400 mm) and Smaller: Cast-iron hub and spigot soil pipe.

a. Pipe and fittings to be service weight and shall comply with ASTM A 74 and bear the collective mark of the Cast Iron Soil Pipe Institute (CISPI).

b. Fittings: Compression gasket joints meeting the requirements of ASTM C 564, or lead and oakum joints.

D. Air Conditioning Condensate (above floor):

1. 2" (50 mm) and Smaller: Copper.

a. Wall Thickness: Type M.

b. Fittings: Solder-joint.

2.5 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Division-22 Section, "Piping Specialties for Plumbing Systems", in accordance with the following listing:

1. Pipe Escutcheons

2. Drip-Pans

3. Pipe Sleeves

4. Sleeve Seals

2.6 SUPPORTS AND ANCHORS

A. General: Provide supports and anchors complying with Division-22 Section, "Hangers and Supports for Plumbing Piping and Equipment".

2.7 SPECIAL VALVES

A. General: Special valves required for storm water piping systems include the following types:

1. Backwater Valves: Cast-iron body, bronze backwater valve assembly swing check type, with cleanout access cover. Provide ends to suit piping material; bolted cover.

2.8 SPECIAL EXPANSION COMPENSATION

A. General: Special expansion compensation products required for storm water piping systems include the following types:

1. Expansion Joints: Cast-iron body, adjustable bronze sleeve, bronze bolts with wing nuts; for vertical installation only.

2.9 SPECIAL PIPING SPECIALTIES

A. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.

2.10 CLEANOUTS

A. General: Provide factory-fabricated cleanouts of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations.

B. Cleanouts in Piping: Cast-iron cleanout ferrule with bronze countersunk plug, suitable for no-hub applications.

C. Cleanouts in finished walls and partitions shall be similar to cleanouts in

piping. Provide round polished stainless steel wall access cover with screw. Finish as per Architect.

D. Cleanouts in Tiled Floor: Cast-iron internal gasketed cleanout plug and adjustable housing with secured scoriated square satin Nickel Alloy top.

E. Cleanouts In Non-Tiled Floor: Similar to tiled floor type with a secured scoriated round satin Nickel Alloy top.

2.11 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division-16 Section "Identification for Plumbing Piping and Equipment".

2.12 INSTALLATION OF STORM WATER PIPING ABOVE GROUND

A. General: Install storm water piping in accordance with Division-22 Section, "Pipe, Tube, and Fittings for Plumbing Systems", and with International Plumbing Code.

2.13 INSTALLATION OF BUILDING DRAIN PIPING

A. General: Install storm building drains as indicated and in accordance with International Plumbing Code. Lay storm building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clear interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

B. Air conditioning (A/C) condensate piping shall be extended from all A/C condensate source equipment (air handling units, fan coil units, unit ventilators, split system A/C units, etc.) and connected to the nearest storm water pipe/drain location. Size per manufacturer.

C. Install storm water piping pitched to drain at minimum slope of 1/8" per foot (10 mm per meter) (1%). Where possible, 1/4" per foot (20 mm per meter) (2%) shall be provided.

2.14 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with requirements of Division-22 Section, "Piping Specialties for Plumbing Systems".

2.15 INSTALLATION OF SUPPORTS AND ANCHORS

A. Install supports and anchors in accordance with Division-22 Section, "Hangers and Supports for Plumbing Piping and Equipment".

2.16 INSTALLATION OF SPECIAL VALVES

A. Backwater Valves: Install in storm water piping as indicated, and as required by International Plumbing Code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover, and of adequate size to remove valve cover for service. Install in such a manner to provide a maximum 1/4" (6 mm) clearance between flapper and seat for air circulation.

2.17 INSTALLATION OF SPECIAL EXPANSION COMPENSATION PRODUCTS

A. Expansion Joints: Install expansion joints on vertical risers as indicated, or as required by International Plumbing Code.

2.18 INSTALLATION OF DRAINAGE PIPING PRODUCTS

A. Cleanouts: Install in conductor piping and storm building drain piping as indicated, as required by International Plumbing Code; at each change in direction of piping greater than 45 degrees; at minimum intervals of 50 feet (15 m) for piping 4" (100 mm) and smaller and 75 feet (23 m) for larger piping; and at base of each conductor. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

B. Flashing Flanges: Install flashing flange and clamping device with each cleanout passing through waterproof membrane.

2.19 PIPING TESTS

A. Test storm water piping system in accordance with requirements of Division-23 Section, "Testing, Adjusting and Balancing".

END OF SECTION

SECTION 22 3000 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of plumbing equipment work is indicated on drawings and provisions of this section, including schedules and equipment lists associated with either drawings or this section.

B. Types of plumbing equipment required for project include the following:

1. Domestic Water Heaters:
    a. Commercial gas-fired water heaters
    b. Commercial electric water heaters
2. Domestic Water Expansion Tanks
3. Interceptors:
    a. Oil interceptors

1.2 QUALITY ASSURANCE

A. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which have been listed and labeled by Underwriters Laboratories and comply with NEMA standards.

B. NEC Compliance: Comply with National Electrical Code (ANSI/NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of plumbing equipment.

C. ANSI Compliance: Comply with ANSI Z223.1 (NFPA 54) "National Fuel Gas Code", as applicable to installation of gas-fired water heaters.

D. ANSI Testing Standard: Water heaters shall comply with ANSI Z21.10.3 testing standard.

E. AGA and NSF Labels: Provide water heaters which have been listed and labeled by American Gas Association and National Sanitation Foundation.

F. ASME Code Symbol Stamps: For the following equipment, comply with ASME Boiler and Pressure Vessel Code for construction, and stamp with ASME Code symbol:

1. Commercial water heaters

2. Domestic water expansion tank

G. ASME Relief Valve Stamps: Provide water heaters with safety relief valves bearing ASME valve markings.

H. PDI Compliance: Comply with applicable Plumbing and Drainage Institute standards pertaining to grease interceptors.

I. Water heaters shall comply with the Energy Policy Act of 2005 (EPACT-2005) and ASHRAE Standard 90.1b regarding energy efficiency. Minimum thermal efficiency shall be 78%.

J. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

K. ASCE-7: Minimum Design Loads for Buildings and Other Structures.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's plumbing equipment specifications, installation and start-up instructions, and capacity and ratings, with selection points clearly indicated.

B. Shop Drawings: Submit assembly type shop drawings indicating dimensions, weights, required clearances, and methods of assembly of all components.

C. Wiring Diagrams: Submit ladder-type wiring diagrams for all components, clearly indicating all required field electrical connections.

D. Maintenance Data: Submit maintenance data and parts lists for each item of plumbing equipment. Include "trouble-shooting" maintenance guides. Include this data in maintenance manual.

E. Manufacturer Seismic Qualification Certification: Submit certification that the water heaters, oil/sand interceptor and accessories will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

   b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

PART 2 - PRODUCTS

2.1 DOMESTIC WATER HEATERS

A. Commercial Gas-Fired Condensing Type Water Heater:

General: Provide commercial condensing type gas-fired water heaters of size and capacity as indicated on schedule. Comply with ANSI/ASHRAE/IES 90A for energy efficiency. Provide certification of design by AGA under Volume III tests for commercial water heaters. Provide approval by NSF and ETL listed.

2. Heater: Working pressure of 150 psi (1020 kPa) fitted with an ASME-rated temperature and pressure relief valve, and conform to ASME Section IV Part HLW for water heater construction. Water heater shall bear the ASME HLW stamp and be National Board listed. Water heaters with full rated input between 399,000 and 600,000 BTU shall operate at a minimum 96% thermal efficiency at full firing rate. Water heater shall be a single-pass, down-fired, fire tube design contained within an integral storage tank. Tank, combustion chamber and fire tubes shall be unlined. All water contacting tank surfaces shall be non-porous and exhibit 0% water absorption. All tank connections/fittings shall be non-ferrous or stainless steel.
3. Safety Controls: Equip with automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank; and pilot safety shutoff.
4. Warranty: Furnish fifteen (15) year limited warranty covering manufacturing or material defects, water-side or fire-side corrosion, tank leakage, and/or production of rusty water. Warranty must be manufacturer-direct and provided on manufacturers signed letterhead. Burner and all heater parts shall have one (1) year warranty.
5. Accessories: Provide brass drain valve; an ASME- rated temperature and pressure relief valve.
6. Controls: Provide gas pressure regulator with atmospheric vent, pilot gas regulator; thermostat; electronic flame monitoring; electronic low water cutoff; an immersion operating control; and an immersion UL listed temperature limiting device. The water heater shall employ an electronic operating control with digital temperature readout. Operator shall be capable of connecting to the building automation system through serial connection using one of the listed protocol gateways below:

    a. BacNet MSTP/IP
    b. Lonworks
    c. Modbus TCP/IP

7. Provide optional condensate neutralization system PVI Model 140794.

8. Acceptable Manufacturers: PVI (basis of design) or approved equal by AO Smith or Lochinvar.

B. Commercial Electric Water Heaters:

1. General: Provide commercial electric water heaters of size, capacity, and electrical characteristics as indicated on schedule.

Comply with ANSI/ASHRAE/IES 90A for energy efficiency. Provide UL listing, and NSF approval.

2.2 DOMESTIC WATER EXPANSION TANK

A. Commercial Potable Water Expansion Tank:

1. General: Provide commercial potable water expansion tank suitable for use with potable water systems and with all wetted surfaces/components of the Food and Drug Administration approved materials. Comply with ASME Section VIII requirements.

2. Removable and replaceable heavy-duty butyl bladder.

3. Suitable for operating temperature up to and including 240°F (116°C).

4. Working pressure 150 PSIG (1034.4 Kpa) minimum. Shall be pre-charged to capacities as shown in schedule or shall be pre-charged to 60 PSI if no schedule is shown on the drawings.

5. Shall have charging valve with pressure gauge, lifting ring and 1" NPT drain connection on the side and on the bottom with plugs. Shall be suitable for horizontal or vertical mounting.

6. Acceptance capacities shall be as shown on the drawings.

2.3 INTERCEPTORS

A. Oil/Sand Interceptors:

1. General: Provide oil/sand interceptor of size and capacity as indicated.

2. Construction: Refer to drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOMESTIC WATER HEATERS

A. Water Heaters (General):

1. General: Install water heaters as indicated, in accordance with manufacturer's installation instructions, and in compliance with

applicable codes.

2. Support: Set units on concrete pads, orient so controls and devices needing service and maintenance have adequate access. Level and plumb unit.

3. Piping: Connect hot and cold water piping to units with unions. Provide shut off valve on cold water line. Connect recirculating water line to unit with shut off valve, check valve, and union.

B. Electric Water Heaters:

1. Electrical Supply: Furnish wiring diagram to Electrical Installer. Refer to Division-26 for wiring of units; not work of this section.

C. Gas-Fired Water Heaters:

1. Gas Supply: Connect to gas line with drip leg, tee, gas cock, and union; full size of unit inlet connection. Locate piping so as not to interfere with service of unit.

2. Flue: Connect flue to draft hood with gas-tight connection.

3. Start-Up: Start-up, test, and adjust gas-fired water heaters in accordance with manufacturer's start-up instructions, and utility company's requirements. Check and calibrate controls, adjust burner for maximum efficiency.

3.2 INSTALLATION OF DOMESTIC WATER EXPANSION TANK

A. Domestic water expansion tank shall be securely suspended from the structure above or shall be pad mounted on a 4" high concrete pad.

B. Tie piping connection into cold water feed line to domestic water heater between shut-off valve and inlet of domestic water heater, or as indicated on the drawings. Provide shut-off valve and union on connecting pipe to allow service and inspection of expansion tank.

3.3 INSTALLATION OF INTERCEPTORS

A. General: Install interceptors as indicated, in accordance with manufacturer's installation instructions, and in compliance with applicable codes.

B. Support: Anchor interceptors securely to substrate, locate so adequate clearance is provided to remove covers and sediment baskets. Set

recessed units so top of cover is flush with finished floor.

C. Piping: Connect inlet and outlet piping to interceptors.

END OF SECTION

SECTION 22 4000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of plumbing fixture work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of plumbing fixtures specified in this section include the following:

1. Water Closets
2. Urinals
3. Lavatories
4. Sinks
5. Mop Basins
6. Showers

C. Refer to Division-22 sections for potable water systems used in conjunction with plumbing fixtures; not work of this section.

D. Refer to Division-22 sections for soil and waste systems used in conjunction with plumbing fixtures; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing fixtures of type, style and configuration required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. Plumbing Fixture Standards: Comply with applicable portions of National Standard Plumbing Code pertaining to materials and installation of plumbing fixtures.
2. ANSI Standards: Comply with applicable ANSI standards pertaining to plumbing fixtures and systems, and bath tub units.

3. PDI Compliance: Comply with standards established by PDI pertaining to plumbing fixture supports.

4. Federal Standards: Comply with applicable FS WW-P-541/-Series sections pertaining to plumbing fixtures.

5. UL Compliance: Construct water coolers in accordance with UL Standards and provide UL listing and label.

6. ANSI Compliance: Construct and install barrier-free plumbing fixtures in accordance with ANSI Standard A117.1 "Specifications for Making Buildings and Facilities Accessible To and Usable By Physically Handicapped People".

   a. Comply with Public Law 90-480, known as the Architectural Barriers Act of 1968.

7. ADA Compliance: Comply with provisions set forth in the "Americans with Disabilities Act Accessibility Guidelines."

8. Lead Free Compliance: All components associated with potable water systems (including, but not limited to, valves, end use devices/fixtures, pipe, pipe fittings, solder/flux, etc.) shall be "lead-free" in accordance with all local, state and federal codes, as well as NSF/ANSI 372 (NSF 61-G).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, furnished specialties and accessories; and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, roughing-in requirements, required clearances, and methods of assembly of components and anchorages.

C. Maintenance Data: Submit maintenance data and parts lists for each type of plumbing fixture and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, and shop drawings in maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver plumbing fixtures individually wrapped in factory-fabricated containers.

B. Handle plumbing fixtures carefully to prevent breakage, chipping and scoring fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. General: Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture unless otherwise noted, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, and as required for complete installation.

Where more than one type is indicated, selection is Installer's option. All fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

WC-1 - Water Closet - Flush Valve: Vitreous china, floor mounted high efficiency toilet (1.28 gal/flush) (4.9 L/flush) with siphon jet action, elongated bowl with heavy duty commercial open front seat less cover, 1-1/2" (40 mm) top spud and Sloan Royal 111-1.28 flush valve (complete with VBF-72-A trap primer where indicated on drawings). Top of rim shall be 15" (381 mm) above finished floor. American Standard "Madera FloWise 15" Height" or equivalent.

WC-2 - Water Closet - Flush Valve - ADA Compliant: Vitreous china, floor mounted high efficiency toilet (1.28 gal/flush) (4.9 L/flush) with siphon jet action, elongated bowl, with heavy duty commercial open front seat less cover, 1-1/2" (40 mm) top spud and Sloan Royal 111-1.28 flush valve (complete with VBF-72-A trap primer where indicated on drawings). Top of rim shall be 16 1/2" (419 mm) above finished floor. American Standard "Madera FloWise 16-1/2" Height" or equivalent.

UR-1 – Urinal: Vitreous china, low water consumption, siphon jet urinal (0.5 gal/flush) (1.9 L/flush), 3/4" (20 mm) top spud and Sloan Regal 186-0.5 flush valve. Mounting height shall be 24" (600 mm) to top of rim. American Standard "Allbrook FloWise" or equivalent.

UR-2 – Urinal – ADA Compliant: Vitreous china, low water

consumption, siphon jet urinal (0.5 gal/flush) (1.9 L/flush), 3/4"(20 mm) top spud and Sloan Regal 186-0.5 flush valve. Mounting height shall be 17" (432 mm) to top of rim. American Standard "Allbrook FloWise" or equivalent.

L-1 - Lavatory - Wall Mounted - ADA Compliant: 18" x 20" (450 mm x 500 mm) vitreous china with front overflow, self-draining deck, narrow wall floor mounted carrier, and 4" (100 mm) centers. Provide fittings 4" (100 mm) on center with 5" (130 mm) cast brass spout, single lever control centerset faucet with 0.5 gpm (.04 L/s) (max) vandal proof aerator. Provide grid drain assembly, flexible supplies, tailpiece and cast brass P-trap and trap arm. Lavatory shall be American Standard "Lucerne" or equivalent. Faucet shall be Chicago Faucet Model 2200-4E2805ABCP. Provide ASSE 1070 point-of-use thermostatic mixing valve, Lawler Model 570, set at 105 degree F (adjustable).

L-2 - Lavatory - Countertop: Self-rimming lavatory with front overflow, faucet ledge and 4" (100 mm) centers. Provide fittings 4" (100 mm) on center with cast brass spout, single lever control centerset faucet with 0.5 gpm (.04 L/s) (max) vandal proof aerator. Provide grid drain assembly, flexible supplies, tail piece and cast brass P-trap and trap arm. Lavatory shall be American Standard "Aqualyn" or equivalent. Faucet shall be Chicago Faucet Model 2200-4E2805ABCP. Provide ASSE 1070 point-of-use thermostatic mixing valve, set at 105 degree F (adjustable).

S-1 - Single Compartment Countertop Sink: 16" x 17" x 6.5" deep (407 mm x 432 mm x 166 mm deep) 18-gauge (1.3 mm) single compartment sink with 4 hole punch. Provide 8" (200 mm) swivel spout with pull-down spray with adjustable spray pattern and single lever control handle, 1.8 gpm (6.8 L/min) (max) aerator, washerless ceramic disc valve cartridge, braided flexible supply hoses and integral check valves, and soap dispenser. Provide chrome basket strainer, flexible supplies, tailpiece and cast brass P-trap. Sink shall be Just Model No. SL-ADA-11617-A-GR and faucet shall be American Standard "Ellis". Provide ASSE 1070 point-of-use thermostatic mixing valve, Lawler 570 or equivalent.

S-2 - Single Compartment Countertop Sink: 16" x 17" x 6.5" deep (407 mm x 432 mm x 166 mm deep) 18-gauge (1.3 mm) single compartment sink with 3 hole punch. Provide 8" (200 mm) swivel spout with pull-down spray with adjustable spray

pattern and single lever control handle, 1.8 gpm (6.8 L/min) (max) aerator, washerless ceramic disc valve cartridge, braided flexible supply hoses and integral check valves, and soap dispenser. Provide chrome basket strainer, flexible supplies, tailpiece and cast brass P-trap. Sink shall be Just Model No. SL-ADA-11617-A-GR and faucet shall be American Standard "Ellis". Provide ASSE 1070 point-of-use thermostatic mixing valve, Lawler 570 or equivalent. Provide ASSE 1070 point-of-use thermostatic mixing valve, Lawler 570 or equivalent.

S-3 - Three Compartment Sink (with no drainboards): 20" x 20" x 14" deep (500 mm x 500 mm x 300 mm deep) 14-gauge type 300 series stainless steel three compartment sink with 2 sets of 2 hole punch on backsplash. Provide (2) swing spout faucets with 4" (100 mm) lever handles, 8" (200 mm) faucet centers, lever drain with overflow and overflow hole, 1.5 gpm (.2 L/s) (max) aerator, flexible supplies, and tailpiece. Sink shall be Eagle Group Model FN2060-3-14/3. Provide ASSE 1070 point-of use thermostatic mixing valve, Lawler 570 or equivalent for each faucet.

S-4 - Single Compartment Sink with Two Drainboards: 20" x 20" x 14" deep (500 mm x 500 mm x 300 mm deep) 14-gauge type 300 series stainless steel three compartment sink with 2 hole punch on backsplash. Provide swing spout faucet with 4" (100 mm) lever handles, 8" (200 mm) faucet centers, lever drain with overflow and overflow hole, 1.5 gpm (.2 L/s) (max) aerator, flexible supplies, and tailpiece. Sink shall be Eagle Group Model FN2020-1-18-14/3. Provide ASSE 1070 point-of use thermostatic mixing valve, Lawler 570 or equivalent.

SH-1 - Shower Fixture (Detachable, Wall Mounted, Concealed Supplies, Thermostatic Valve) and Wall Mounted Shower Faucet:

Shower Installation: Wall mounted detachable spray assembly, 24-inch (600 mm) wall bar, elevated vacuum breaker, supply elbow and flange and valve. All external trim, chrome plated metal.

Shower Head Assembly: Plastic shower head with flow control to limit discharge to 1.5 gpm (.13 L/s), 5-foot (1.5 m) length of rubber lined CRS, chrome plated metal flexible, or white vinyl reinforced hose and supply wall elbow. Design shower head to fit in palm of hand. Provide CRS or chrome plated metal

wall bar with an adjustable swivel hanger for shower head. Fasten wall bar securely to wall for hand support.

Valves: Thermostatic type T/P combination temperature and pressure balancing, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 1/2-inch (13 mm) IPS.

Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 105 degrees F. All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 6 gpm at 45 psi (310 kPa) gage pressure drop.

Shower Faucet: Provide wall mounted manual sink faucet with adjustable centers, vandal proof 2-3/8" lever handles, 5-3/4" L-type swing spout with atmospheric vacuum breaker, ¾" threaded hose end connection, chrome plated, Chicago Faucets Model 540-LDL5VBCP, mount faucet at 30" above shower base.

SH-2 - Shower Fixture (Detachable, Wall Mounted, Concealed Supplies, Thermostatic Valve):

Shower Installation: Wall mounted detachable spray assembly, 24-inch (600 mm) wall bar, elevated vacuum breaker, supply elbow and flange and valve. All external trim, chrome plated metal.

Shower Head Assembly: Plastic shower head with flow control to limit discharge to 2 gpm (.13 L/s), 5-foot (1.5 m) length of rubber lined CRS, chrome plated metal flexible, or white vinyl reinforced hose and supply wall elbow. Design shower head to fit in palm of hand. Provide CRS or chrome plated metal wall bar with an adjustable swivel hanger for shower head. Fasten wall bar securely to wall for hand support.

Valves: Thermostatic type T/P combination temperature and pressure balancing, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 1/2-inch (13 mm) IPS.

Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 105 degrees F. All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 6 gpm at 45 psi (310 kPa) gage pressure drop.

MB-1 - Mop Basin - Floor Mounted: One piece, white molded stone, 24" x 24" x 10" deep, factory installed stainless steel drain body with strainer, fitted with stainless steel wall guard, vinyl bumper guards, wall mounted faucet with vacuum breaker spout, mop hanger, and hose with bracket. Mop basin shall be Fiat Model MSB-2424 and faucet shall be Chicago Model 897 or equivalent.

WMC-1 – Washing Machine Connection Utility Box - Wall Mounted: 16 gauge (1.6 mm) stainless steel, overflow guard, and satin plated faucets and connectors and water hammer arresters. Unit shall be fire rated Guy Gray FR-12 Series as required by domestic water and waste piping arrangement.

IMC-1 – Ice Maker Connection Utility Box – Wall Mounted: 16 gauge (1.6 mm) stainless steel, overflow guard and plated quarter-turn ball valve with integral hammer arrester. Unit shall be fire rated Guy Gray FR1B12 Series.

B. All plumbing fixtures indicated to be ADA compliant on the mechanical or architectural drawings shall comply with the "Americans with Disabilities Act Accessibility Guidelines". ADA compliant plumbing fixtures shall meet the latest ADA requirements and installation guidelines shall include, but not be limited to, the following:

Water Closets: Top of seat greater than 17 inches (425 mm) but not to exceed 19" (475 mm) above finished floor. Flush valve not to exceed 44" (1100 mm) above finished floor.

Urinals: Top of rim shall not exceed 17" (425 mm) above finished floor. Flush valve not to exceed 44" (1100 mm) above finished floor.

Lavatories: Top of rim or counter shall not exceed 34" (850 mm) above finished floor. Faucets may be lever operated, push button or electronically controlled; however, the faucet must remain open for a minimum of 10 seconds. Faucets also must not require more than five pounds of force to activate the control, and the control must be operable without tight grasping, pinching or twisting of the wrist. Where piping is exposed beneath the lavatory, provide manufactured

premolded insulated pipe for exposed hot water, cold water and sanitary drain piping; Lavguard or equivalent.

Showers: Controls must be located adjacent to the entrance and are required to be above 38" (950 mm) but no higher than 48" (1200 mm) from the floor. Shower sprayers must have both fixed and hand-held use capabilities, with a 60" (1500 mm) flexible hose. (A fixed head may be used in vandal-prone areas.) Controls require activation pressures not exceeding five pounds (34 kPa) of force nor requiring tight grasping, pinching or twisting of the wrist.

2.2 MATERIALS

A. General: Unless otherwise specified, comply with applicable Federal Specification WW-P-541 Series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with requirements of WW-P-541 specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps, and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541.

B. Provide materials which have been selected for their surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration, or other surface imperfections on finished units are not acceptable.

C. Where fittings, trim and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless steel units. Provide copper or brass where not exposed.

D. Stainless Steel Sheets: ASTM A 167, Type 302/304, hardest workable temper.

1. Finish: No. 4, bright, directional polish on exposed surfaces.

E. Steel Sheets for Baked Enamel Finish: ASTM A591, coating Class C, galvanized-bonderized.

F. Steel Sheets for Porcelain Enamel Finish: ASTM A424, commercial quality, Type I.

G. Galvanized Steel Sheet: ASTM A526, except ASTM A527 for extensive forming; ASTM A525, G90 zinc coating, chemical treatment.

H. Aluminum: ASTM B209/B221 sheet, plate and extrusions, as indicated; alloy, temper and finish as determined by manufacturer, except 0.40 mil

natural anodized finish on exposed work unless another finish is indicated.

I. Plastic Laminate: NEMA LD3, general purpose high pressure type, 0.050" thick, smooth (non-textured) white unless another texture and color are indicated or selected by the Owner.

J. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes and specks; glaze exposed surfaces, and test for crazing resistance in accordance with ASTM C 554.

K. Fiberglass: ANSI Z124, smooth surfaced, with color selected by the Owner.

L. Synthetic Stone: High quality, free from defects, glaze on exposed surfaces, stain resistant.

2.3 PLUMBING FITTINGS, TRIM AND ACCESSORIES

A. Water Outlets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, or dispensing devices, of type and size indicated, and as required to operate as indicated. Include manual shutoff valves and connecting stem pipes to permit outlet servicing without shut-down of water supply piping systems.

1. Vacuum Breakers: Provide with flush valves where required by governing regulations, including locations where water outlets are equipped for hose attachment.

B. P-Traps: Include removable P-traps where drains are indicated for direct connection to drainage system.

C. Provide cast-iron supports for fixtures of either graphitic gray iron, ductile iron, or malleable iron as required.

D. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

E. Escutcheons: Where fixture supplies and drains penetrate walls in exposed locations, provide chrome-plated sheet steel escutcheons with friction clips.

F. Aerators: Provide aerators of types approved by the Owner, and complying with flow constrictions, hereinbefore specified.

G. Comply with additional fixture requirements contained in fixture schedule indicated on the Drawings.

2.4 TRAP PRIMERS

A. Prime all floor drain and floor sink traps with trap seal primer valve having integral vacuum breaker.

B. Install primer valve in cold water service line to nearest plumbing fixture and extend in concealed copper piping to trap.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PLUMBING FIXTURES

A. General: Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of National Standard Plumbing Code pertaining to installation of plumbing fixtures.

B. Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.

C. Protect installed fixtures from damage during remainder of construction period.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by the Owner. Remove cracked or dented units and replace with new units.

3.4 ADJUSTING AND CLEANING

A. Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation.

B. Adjust water pressure at water coolers, faucets, shower valves, and flush valves to provide proper flow stream and specified gpm.

C. Adjust or replace washers to prevent leaks at faucets and stops.

3.5 EXTRA STOCK

A. General: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to the Owner with receipt. Furnish one (1) device for every ten (10) units.

END OF SECTION

SECTION 22 6300 - NATURAL GAS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of natural gas systems work is indicated on drawings and schedules, and by requirements of this section.

B. Refer to Division-02 sections for trenching and backfill required in conjunction with gas service piping; not work of this section.

1.2 QUALITY ASSURANCE

A. Specimen Joints: Before commencing pipe laying, Contractor shall form specimen joints to demonstrate, to the satisfaction of the Owner, that materials and methods employed will result in watertight joints.

B. Qualification of Installers: The entire gasket system shall be installed by trained workmen skilled in the installation of such systems.

C. Structural Performance: Pipe hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

D. Codes and Standards:

1. ASME Compliance: Fabricate and install natural gas piping in accordance with ASME B31.2 "Fuel Gas Piping".

2. NFPA Compliance: Fabricate and install natural gas systems in accordance with NFPA 54 "National Fuel Gas Code".

3. Utility Compliance: Fabricate and install natural gas systems in accordance with local gas utility company.

4. UMC Compliance: Fabricate and install natural gas systems in accordance with IAPMO "Uniform Mechanical Code".

5. ASCE-7: Minimum Design Loads for Buildings and Other Structures.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for natural gas systems materials and products.

B. Maintenance Data: Submit maintenance data and parts lists for natural gas systems materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

C. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, pipes, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with NFPA 54 where applicable and base pressure rating on natural gas piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials use in natural gas systems. Where more than one type of materials or products is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-22 sections "Basic Plumbing Materials and Methods" and "Identification for Plumbing Piping and Equipment", in accordance with the following listing:

1. Building Distribution Piping: Plastic pipe markers.

2. Gas Service: Underground-type plastic line markers.

3. Gas Valves: Plastic valve tags.

2.3 BASIC PIPES AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings complying with Division-22 sections "Basic Plumbing Materials and Methods" and "Pipe, Tube and

Fittings for Plumbing Systems", in accordance with the following listing:

B. Gas Service Piping:

1. All Pipe Sizes: Black steel pipe; Schedule 40; wrought-steel buttwelding.

a. Wrapping: Machine wrap pipe using 50% overlap wrap, with polyvinyl chloride tape. Hand wrap fittings using 100% overlap wrap extending 6" (150 mm) beyond fitting onto wrapped pipe. Comply with tape manufacturer's installation instructions.

C. Building Distribution Piping:

1. Pipe Size 2" (50 mm) and Smaller: Black steel pipe; Schedule 40; malleable-iron threaded fittings.

2. Pipe Size 2-1/2" (65 mm) and Larger: Black steel pipe; Schedule 40; wrought-steel buttwelding fittings.

2.4 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Division-22 sections "Basic Plumbing Materials and Methods" and "Piping Specialties for Plumbing Systems", in accordance with the following listing:

1. Pipe escutcheons

2. Vandal-proof vent caps

3. Dielectric fittings

4. Pipe sleeves

5. Sleeve seals

2.5 BASIC SUPPORTS AND ANCHORS

A. General: Provide supports and anchors complying with Division-22 sections "Basic Plumbing Materials and Methods" and Hangers and Supports for Plumbing Piping and Equipment", in accordance with the following listing:

1. Adjustable swivel pipe rings for horizontal-piping hangers and supports.

2. Two-bolt riser clamps for vertical piping supports.

3. Concrete inserts, C-clamps, and steel brackets for building attachments.

2.6 SPECIAL VALVES

A. General: Special valves required for natural gas systems include the following types:

1. Gas Cocks:

a. Gas Cocks 2" (50 mm) and Smaller: 150 psi (1020 kPa) non-shock WOG, bronze straightway cock, flat or square head, threaded ends.

b. Gas Cocks 2-1/2" (65 mm) and Larger: 125 psi (850 kPa) non-shock WOG, iron body bronze mounted, straightway cock, square head, flanged ends.

2. Control Valves:

a. Master Gas Control Valve: Bronze body, packless, single seat, explosion-proof, solenoid operated, normally closed, UL approved, automatic reset, 120 volt.

2.7 PRESSURE REGULATING VALVES

A. General: Where required, provide single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; with threaded ends for 2" (50 mm) and smaller, flanged ends for 2-1/2" (65 mm) and larger; for inlet and outlet gas pressures, specific gravity, and volume flow indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which natural gas systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division-22 sections "Basic Plumbing Materials and Methods" and "Identification for Plumbing Piping and Equipment".

3.3 INSTALLATION OF NATURAL GAS PIPING

A. General: Install natural gas piping in accordance with Division-22 sections "Basic Plumbing Materials and Methods" and "Pipe, Tube and Fittings for Plumbing Systems"; and in accordance with applicable codes and local Utility Company requirements.

1. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.

2. Remove cutting and threading burrs before assembling piping.

3. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.

4. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.

5. Ground gas piping electrically and continuously within project, and bond tightly to grounding connection.

6. Install drip-legs in gas piping where indicated, and where required by regulation.

7. Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.

8. Use dielectric fittings where dissimilar metals are joined together.

9. Install piping with 1/64" per foot (1.3 mm per meter) (1/8%) downward slope in direction of flow.

10. Install piping parallel to other piping, but maintain minimum of 12" (300 mm) clearance between gas piping and steam or hydronic piping above 200°F (93°C).

11. Insulate gas piping exposed to freezing temperatures.

12. For piping underground beneath buildings, install in welded conduit.

Extend conduit inside and terminate in accessible portion of building and seal. Extend conduit outside minimum of 4" (100 mm) from building, and vent above grade.

13. For piping running through ducts or air plenums, install in welded conduit, ventilated on both ends.

14. For risers running through concrete or asphalt, install through minimum 6" (150 mm) pipe sleeve. Fill annular space with gravel.

15. Install magnesium anodes for underground steel pipe, one 5-lb (2.3 L) anode for up to 100' (30 m) in length and one 5-lb (2.3 L) anode for each additional 100' (30 m).

16. Install magnesium anodes for each underground steel or malleable iron fitting, isolated between two (2) sections of plastic pipe; one 3-lb (1.4 L) anode for each fitting.

3.4 GAS SERVICE

A. General: Arrange with Utility Company to provide gas service to indicated location with shutoff at terminus. Consult with Utility as to extent of its work, costs, fees and permits involved. Pay such costs and fees; obtain permits.

1. Provide shutoff in gas service pipe at entry in building, extend pipe to gas meter location indicated; provide parts and accessories required by Utility to connect meter.

3.5 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Division-22 sections "Basic Plumbing Materials and Methods" and "Piping Specialties for Plumbing Systems".

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Install supports and anchors in accordance with Division-22 sections "Basic Plumbing Materials and Methods" and "Hangers and Supports for Plumbing Piping and Equipment".

3.7 INSTALLATION OF VALVES

A. Gas Cocks: Provide at connection to gas train for each gas-fired

equipment item; and on risers and branches where indicated.

1. Locate gas cocks where easily accessible, and where they will be protected from possible injury.

B. Control Valves: Install as indicated. Refer to Division-26 for wiring; not work of this section.

C. Pressure Regulating Valves: Install as required to reduce pressure to meet the requirements of each piece of equipment. Valve shall comply with utility requirements. Pipe atmospheric vent to outdoors, full size of outlet. Install gas shutoff valve upstream of each pressure regulating valve.

3.8 INSTALLATION OF GAS METER

1. Set meter on concrete pad as indicated.

3.9 EQUIPMENT CONNECTIONS

A. General: Connect gas piping to each gas-fired equipment item, with drip leg, shutoff gas cock and pressure regulating valve. Comply with equipment manufacturer's instructions.

3.10 FIELD QUALITY CONTROL

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

3.11 ADJUSTING AND CLEANING

A. Cleaning and Inspecting: Clean and inspect natural gas systems in accordance with requirements of Division-22 sections "Basic Plumbing Materials and Methods" and "Pipe, Tube and Fittings for Plumbing Systems".

3.12 SPARE PARTS

A. Valve Wrenches: Furnish to the Owner, with receipt, two (2) valve wrenches for each type of gas valve installed, requiring same.

END OF SECTION

SECTION 23 0100 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. The complete set of Architectural, Structural, Civil, Mechanical, Plumbing, and Electrical drawings, specifications, and addenda apply to this work.

B. Unless otherwise modified, provisions of General Conditions, Supplementary Conditions and Division-01 govern work under the Mechanical Divisions.

C. Contract drawings for mechanical work are diagrammatic, intended to convey scope and general arrangement. Contractor shall review and coordinate routing of new work at no cost to the Owner. All dimensions of existing conditions shall be considered approximate (for information only). All dimensions shall be verified prior to construction.

D. Contract Document Interpretation/Discrepancies:

1. Should the Contractor discover any discrepancies or omissions on the drawings or in the specifications, he shall notify the Architect/Engineer (A/E) of such conditions prior to the bid date. Otherwise, it will be understood that the drawings and specifications are clear as to what is intended and shall be as interpreted by the A/E.

2. In addition, should any contradiction, ambiguity, inconsistency, discrepancy or conflict appear in or between any of the Contract Documents, the Contractor, shall, before proceeding with the work in question, notify the A/E and request an interpretation. In no case shall he proceed with the affected work until advised by the A/E.

3. If the Contractor fails to make a request for interpretation of discrepancies or conflicts in the drawings or specifications, no excuse will be accepted for failure to carry out the work in a satisfactory manner, as interpreted by the A/E. In all cases, the Contractor will be deemed to have estimated the most stringent materials and methods (i.e. the highest quality materials and most expensive manner of completing the work) unless he has requested and obtained written authorization as to which methods or materials will be required.

4. Each and every trade or subcontractor will be deemed to have familiarized himself with all drawings of this project, including Site/Civil, Architectural, Structural, Mechanical, Electrical, Information Technology, etc. so as to avoid coordination errors, omissions, and misinterpretations. No additional compensation will be authorized for alleged errors, omissions, and misinterpretation, whether they are a result of failure to observe these requirements or not.

E. The complete set of Architectural, Structural, Civil, Mechanical, and Electrical drawings, specifications, and addenda apply to this work.

1.2 SCOPE

A. The work in Division-23 includes furnishing and installing the mechanical systems complete and ready for satisfactory service.

B. Requirements specified govern work in all sections of Division-23.

1.3 REFERENCES

A. References to standards, codes, catalogs and recommendations are latest edition in effect on date of invitation to bid.

B. Refer to applicable contract drawings, specifications and addenda pertaining to other divisions for conditions affecting work.

C. Refer to Division-01 for description of alternates.

D. Refer to Division-01 for description of allowance items.

E. Refer to Division-01 for description of base bid items.

F. Refer to Division-01 for description of demolition items.

1.4 DEFINITIONS

A. Following are definitions of terms and expressions used in this Division:

1. "Approve" - to permit use of material, equipment or methods conditional upon compliance with contract document requirements.

2. "Concealed" - hidden from normal sight; includes work in crawl spaces, above ceilings, and in building shafts.

3. "Directed" - directed by Engineer.

4. "Ductwork" - includes ducts, fittings, housings, dampers, supports and accessories comprising a system.

5. "Equal, equivalent" - possessing the same performance qualities and characteristics and fulfilling the same utilitarian function.

6. "Exposed" - not concealed.

7. "Indicated" - indicated in Contract Documents.

8. "Piping" - includes pipe, fittings, valves, supports and accessories comprising a system.

9. "Provide" - furnish and install.

10. "Removable" - detachable from the structure or system without physical alteration of materials or equipment or disturbance to other construction.

11. "Review" - limited observation or checking to ascertain general conformance with design concepts and general compliance with contract document requirements. Such action does not constitute a waiver or alteration of the contract requirements. Verification of quantities and dimensions shall be the responsibility of the Contractor.

12. "Appurtenances" - a device or assembly installed in the referenced system which performs some useful referenced function in the operation, maintenance, servicing, economy or safety of the system. Some examples include, but are not limited to aerators, anchors, supports, gauges, backflow preventers, expansion tanks, filters, flow controls, interceptors, meters, pressure reducing valves, relief valves, dampers, separators and similar devices.

13. "Record Documents" - drawings, plans and specifications that indicate the nature and location of work reported by Contractors, but not verified by Consultant. Record documents cannot be considered reliable; as they are based on information reported by the Contractor only and is not verified by the Architect or Engineer (A/E).

1.5 RIGGING REQUIREMENTS

A. Prior to bidding, the Contractor shall verify that all equipment can be

physically rigged to the proposed location without disturbance or dismantling of any existing or new physical obstacles. Should the rigging of any new equipment appear to be an issue, the Contractor shall inform the Architect or Engineer (A/E) seven (7) days prior to the bid date that the rigging of the new equipment may present a problem. Otherwise, the Contractor shall, in accordance with the manufacturer's approval and without voiding warranties and/or certifications, have the equipment "broken down" into sections as required to install the equipment in its proposed location without disturbance or dismantling of any existing or new physical obstacles.

B. Failure to inform the Architect or Engineer (A/E) seven (7) days prior to the bid of any rigging problems will result in the Contractor accepting full responsibility for all modifications to the equipment or the physical obstacles required to install the equipment in its proposed location without additional cost to the Owner.

1.6 CONTRACTOR'S INSTALLATION DRAWINGS

A. Prior to fabrication and installation, submit shop drawings (min. scale - 1/4" = 1' - 0") illustrating all ductwork, HVAC piping, plumbing piping, lighting fixtures, cable tray, conduit, expansion loops, supports, alignment guides and fire protection coordinated with each other and with the structure. Installation drawings shall be reviewed by Owner's representative prior to fabrication and installation of any new work and prior to the ordering of any mechanical equipment.

B. Should the Contractor not provide the coordinated installation drawings required above, the following shall apply:

1. The Contractor shall accept full and absolute responsibility for the coordination of all project materials and equipment to be installed as indicated on the contract documents.

2. Proposed change orders and/or time extensions will not be accepted for any additional work that results from coordination related changes.

3. A credit shall be issued to the Owner for the value of the coordinated installation drawings; the value of the credit to the Owner shall be as determined by the A/E.

C. Computer (CADD) files of mechanical drawings (HVAC, etc.) will not be made available to the Contractor for use in the preparation of coordinated drawings, shop drawings or any other use.

1.7 MATERIAL, EQUIPMENT AND SUBSTITUTION REQUIREMENTS

A. Use products of one manufacturer where two or more items of same kind of equipment are required.

B. Materials and equipment shall have a record of two (2) years successful field use.

C. Where a specific manufacturer is listed on the drawings, that manufacturer shall be considered the basis of design for that particular item of equipment. Only the basis of design manufacturer has been verified to meet the project requirements (i.e. dimensions, weights, service clearances, electrical requirements, etc.).

D. Where the drawings and/or specifications indicate more than one manufacturer for a particular item of equipment, only those listed may submit products and services to be included in the work; manufacturers other than those listed will not be acceptable. Should the contractor choose to use one of the specified manufacturers other than the basis of design, it shall be the responsibility of the contractor to verify that the equipment meets all project requirements including, but not limited to, verification of all dimensions, weights, service clearances, electrical requirements, etc. All changes incurred shall be the responsibility of the contractor and shall be provided at no additional cost to the owner.

E. Substitutions must be submitted for consideration seven (7) days prior to the original bid date. Consideration of substitutions shall be at the sole discretion of the Engineer. Substitution submittals shall include all information required in the "Submittals" paragraph of this specification section, as well as all other requirements indicated through the Division-23 specifications. Substitutions will not mitigate, in any way, the Contractor's responsibility in complying with the coordination, contract requirements or design intent. Any additional electrical, structural or special requirements, etc. shall be the responsibility of the Contractor. Also, any additional cost incurred as a result of substitution shall be the responsibility of the Contractor.

F. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

G. Where items of equipment are indicated as Base Bid on the bid form include in the Bid price the cost of providing the equipment upon which

the specification is based. In addition, submit with bid for Owner's consideration the amount to be added or deducted from the base bid for other listed manufacturers' equipment. Owner will advise Contractor within forty-five (45) days after award of contract of his selection.

1.8 MATERIAL AND EQUIPMENT LIST

A. Within thirty (30) days after award of the contract, submit for Engineer's review a list of subcontractors' and manufacturers' names for items proposed for this project.

1.9 SUBMITTALS

A. Where the drawings and/or specifications indicate more than one allowable manufacturer for a particular piece of equipment and/or product, only those manufacturers indicated may submit products and services to be included in the work. Unless otherwise indicated, manufacturers other than those listed will not be acceptable.

B. Submit shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review.

C. Shop Drawings: Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment. Include equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, drawings shall be revised to show acceptable equipment and be resubmitted. All equipment and/or products shall be submitted by an authorized factory representative of that particular product.

D. Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

E. Standards Compliance: When materials or equipment must conform to

the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted to the Engineer for review. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable testing. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for review. The certificate shall identify the manufacturer, the product, and the referenced standard and shall simply state that the manufacturer certifies that the product conforms to all requirements of the project specification and of the referenced standards listed.

F. Contractor shall thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission and coordinate installation requirements for equipment submitted, including, a) the verification of equipment weights relative to the new structural support system and b) the verification of equipment dimensions relative to new architectural conditions. Contractor shall be responsible for correctness of all submittals.

G. Submittals will be checked only for general conformance with the design concept and are subject to the original contract documents, as well as any corrections and comments noted. Comments noted, if any, will not be considered a complete list of all omissions, deviations and corrections necessary to meet the requirements of the contract documents. The contractor will be responsible to confirm that the final product and installation will be in conformance with the contract documents in their entirety, including the responsibility to fully coordinate all work with other trades and to confirm the correctness of dimensions, quantities, and capacities. Submittal review does not authorize or constitute a change to the contract requirements and does not release the contractor of responsibility to conform to the contract requirements. Requirements of the contract are not waived by review of any and all substitutions. The contractor must fulfill the terms of the contract.

H. Compliance Review Form: Each equipment submittal must include a

Compliance Review Form formatted as follows:

1. Section 1: Certify that the submittal is in complete compliance with the plans and specifications, except for the numbered and footnoted deviations and exceptions as defined herein. Deviations or exceptions taken in a cover letter or by contradiction or omission shall not constitute a release from the requirement that the equipment be in complete compliance with the plans and specifications.

2. Section 2: Provide a detailed paragraph by paragraph annotation of the specification with an individual "C", "D", or "E" noted in the margin, as follows:

    a. "C" shall mean compliance with no exceptions. Provide a numbered footnote (i.e. C1, C2, C3, etc.) for each comment or clarification.

    b. "D" shall mean compliance with deviations. For each deviation, provide a numbered footnote (i.e. D1, D2, D3, etc.) with a detailed explanation of how the intent of this specification is to be satisfied.

    c. "E" shall mean exception. The equipment offered is not in compliance with the specifications. For each exception, provide a numbered footnote (i.e. E1, E2, E3, etc.) with a detailed description of the exception.

I. Electronic Submittals: Should the contractor elect to submit electronic shop drawings/submittals, the procedure shall be as follows:

1. Provide a transmittal with the electronic shop drawing/submittal indicating that the document was transmitted electronically. Transmittal shall also include verification of the contractor's review indicating compliance with the contract documents in accordance with paragraph 1.09.F of this section.

2. Sequentially number all pages on the electronic shop drawing/submittal. The total number of pages shall be reflected in the transmittal.

3. Submittal review comments shall be transmitted electronically. Large documents will be scanned with comments as necessary and returned electronically.

4. All shop drawings such as, but not limited to: coordination drawings, ductwork shop drawings, fire alarm drawings, ductbank layouts, etc.

shall be submitted in hard copy, full size format.

5. Provide hard copy of the shop drawing/submittal for each of the Operations and Maintenance Manuals.

6. Failure to comply with the above will result in the submittal being returned and marked "Not Reviewed".

J. Submittals will be reviewed for general compliance with design concept in accordance with contract documents. Dimensions, quantities, weights, or other details will not be verified by the A/E; this is the responsibility of the Contractor.

K. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

L. Review Period: BKM shall be allotted two (2) weeks for the processing, review and return of all submittals. It shall be incumbent upon the Contractor to include this time period in their schedule.

1. Resubmittals: BKM shall be allotted an additional two weeks (14 days) for the review of each resubmittal. Again, it shall be the Contractor's responsibility to submit the appropriate materials in a timely fashion.

2. Contract Extension: No extension in contract time will be authorized as a result of the timeline addressed above.

M. Submittal Identifications:

1. Place a permanent label or title block on each submittal for identification.

2. Indicate name of firm or entity that prepared each submittal on label or title block.

3. Provide a space approximately 4 by 5 inches on label or beside title block to record contractor's review and approval markings and action taken by A/E.

4. Include the following information on label for processing and recording action taken:

a. Project name

b. Date

c. Name and address of A/E

d. Name and address of contractor

e. Name and address of subcontractor

f. Name and address of supplier

g. Name of manufacturer

h. Unique identifier, including revision number

i. Number and title of appropriate specification section

j. Drawing number and detail references, as appropriate

k. Other necessary identification

l. Example: 230700-01-0

1) 230700 references the spec section

2) 01 indicates this is the first submittal from this spec section

3) 0 indicates this is the original submittal (where 1 would indicate this is the first re-submittal)

N. The engineer will provide a maximum of two (2) submittal reviews per equipment submittal; the initial review plus one (1) re-submittal. Should the re-submittal be returned "Not Acceptable" or "Revise and Resubmit", the contractor shall choose one of the following courses of action:

1. Provide the exact manufacturer and model indicated in the contract documents as the basis of design, or

2. Reimburse the engineer for all additional review time required to achieve a submittal review from the engineer of "No Exceptions Taken."

3. Should the contractor choose option 2 above, the engineer shall be reimbursed at an hourly rate of $175 per hour with payment due prior to the return of the final submittal. In addition, the contractor shall accept complete responsibility for all delays resulting from the submittal review process extending beyond two (2) reviews per equipment submittal.

O. Resubmittals: Resubmittals shall comply with paragraph 1.09 of this section and the following additional requirements.

1. Resubmittals shall include a written response to each submittal comment. Provide a detailed comment by comment annotation of the submittal review comments with an individual "C", "D", or "E" as follows:

   a. "C" shall mean compliance with no exceptions. Provide a numbered footnote (i.e. C1, C2, C3, etc.) for each comment or clarification.

   b. "D" shall mean compliance with deviations. For each deviation, provide a numbered footnote (i.e. D1, D2, D3, etc.) with a detailed explanation of how the intent of this specification is to be satisfied.

   c. "E" shall mean exception. The equipment offered is not in compliance with the specifications. For each exception, provide a numbered footnote (i.e. E1, E2, E3, etc.) with a detailed description of the exception.

1.10 MANUFACTURER'S RECOMMENDATIONS

A. Installation procedures are required to be in accordance with the recommendations of the manufacturer of the material being installed.

1.11 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

1.12 SAFETY REQUIREMENTS

A. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts located so that any person can come in close proximity thereto shall be fully enclosed or properly guarded in accordance with OSHA. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein. Items such as catwalks, ladders, and guardrails shall be provided where required for safe operation and maintenance of equipment.

1.13 WORKMANSHIP

A. Remove and replace, at no extra cost, all work not orderly, reasonably neat, or workmanlike.

B. Coordinate all work and cooperate with other trades to facilitate execution of work.

1.14 SITE EXAMINATION

A. Failure to visit site and become familiar with existing conditions prior to bidding will not relieve the Contractor of responsibility for complying with the Contract documents.

1.15 REGULATIONS AND PERMITS

A. Comply with all applicable codes and regulations.

B. All equipment provided shall be in accordance with all applicable local, state, and federal codes, guidelines and standards, as well as the authority having jurisdiction. Equipment and installation shall be in compliance with all applicable energy codes including the most current version of ASHRAE Standard 90.1.

C. Obtain and pay for all required permits.

1.16 CUTTING AND PATCHING

A. Unless otherwise directed, do all cutting and patching. Damaged work, including fireproofing and waterproofing shall be repaired by skilled mechanics of the trade involved.

B. Do not cut walls, floors, roofs, reinforced concrete or structural steel without structural Engineer's permission. Install services without affecting reinforcing steel.

C. In precast concrete plank drill all holes with a Carboloy tipped drill. Follow instructions of structural Engineer. Cut no reinforcing bars.

1.17 LINTELS

A. Under this Section provide all lintels not provided elsewhere which are required for openings for the installations of mechanical work. Lintels shall meet the requirements of the structural sections.

1.18 CLEANING UP

A. Keep premises free from accumulation of debris.

B. Remove tools, scaffolding, surplus material, debris, and leave premises broom clean.

C. On discontinuance of part of the work, place all debris in containers and promptly remove them from the Owner's property.

D. Leave all areas broom clean.

E. Final clean-up shall be performed.

1.19 AREAS REQUIRING SPECIAL FINISHES/PAINTING

A. In kitchens and utility rooms [polish chromium or nickel plate] [paint as specified under Painting] all exposed and uninsulated piping including valves, traps, strainers and appurtenant items; and exposed electrical work including conduit, boxes, switches starters and disconnects. Finish shall not be applied to nameplates, pushbuttons. Stainless steel housing and plates require no plating or paints.

B. Provide surface preparation, priming and painting of all mechanical and boiler room floors to provide a smooth, cleanable surface. Primer and paint shall be appropriate for concrete slab surfaces. See specification sections "Painting" and “HVAC Related Work”, where applicable, for additional painting requirements. Color shall be selected by the A/E.

1.20 PROTECTION

A. Protect mechanical and electrical material and equipment from the elements or other injury as soon as delivered on premises.

B. Cap or plug openings in equipment, piping, duct, and conduit systems to exclude dirt and other foreign material. Rags, wool, cotton, paper, waste or similar materials shall not be used for plugging.

C. Unless approved by Owner, HVAC equipment shall not be used for temporary heating or ventilation during construction.

D. Contractor shall provide temporary cooling and heating as required to protect all construction materials from the potential adverse effects of high or low temperature and humidity. Upon delivery of ceiling and other

finish materials to a location within the building, environmental conditions in all spaces where the materials will be either stored or installed shall be permanently maintained at 75°F (+2°F) and 50% RH (+5%). Should the HVAC include a reheat system, the reheat system shall be energized to provide temperature and humidity control whenever the HVAC system is energized. Contractor shall pay for all utility, fuel, operational, maintenance and repair costs associated with providing the environmental conditions indicated above until the owner accepts occupancy of the building.

1.21 CLEANING OF SYSTEMS

A. After satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers and other accessory items, thoroughly clean all systems. Blow out and flush piping until interiors are free of foreign matter.

B. Flush piping in recirculating water systems to remove all cutting oil, excess pipe joint compound and other foreign materials. Furnish necessary temporary pumping equipment to thoroughly clean the water piping. Do not use any system pump until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling the residual alkalinity shall not exceed 300 parts per million. Work shall be performed or supervised by a qualified water treatment service company with personnel skilled in the safe and proper use of chemicals and in testing procedures. After completion, submit a certificate of completion to Engineer stating name of the service company used.

C. Leave strainers and dirt pockets in clean condition.

D. Clean fans, ductwork, enclosures, flues, registers, grilles and diffusers at completion of work.

E. Permanent air systems operated for temporary heating during construction shall only be operated with filters installed of equal efficiency to those specified. Prior to acceptance and after cleaning of system, replace with clean filters as specified. Return air openings shall be equipped with filter cloth to protect against debris entering the ductwork.

1. If upon periodic inspection, it is determined that the permanent ductwork has become contaminated with construction debris, then the contractor shall be required to procure the services of a professional duct cleaning agency prior to substantial completion, at no additional cost to the Owner.

F. Should any system become clogged with construction refuse after acceptance, the contractor shall pay for all labor and materials required to locate and remove the obstruction and replace and repair work disturbed.

G. Leave all systems clean, and in complete running order.

H. Equipment that has been subjected to the elements shall be cleaned of all rust, dirt and debris and repainted to match original finish.

1.22 FUNCTIONAL PERFORMANCE TESTING AND VERIFICATION

A. General: In addition to the tests required during and after installation of all mechanical systems, as well as any other formal commissioning requirements, the Contractor shall perform functional performance tests to verify that all systems are designed, installed, calibrated and adjusted to perform as required in the Contract.

B. Comply with all applicable specification sections including, but not be limited to, "Basic HVAC Requirements", "Testing, Adjusting and Balancing", "Automatic Temperature Controls" and "Commissioning", where applicable.

C. Prior to functional performance testing, all indicating, recording and control devices shall be calibrated. A verification calibration report shall be provided with the final test report.

D. Provide functional performance testing to verify proper operation of each and every control sequence indicated throughout the contract documents.

E. Failure of Tests: Should any test, verification, or demonstration fail to meet the specification requirements, the component of the system causing the failure shall be repaired, replaced or readjusted. The failed test, verification, or demonstration shall then be repeated.

F. A "Functional Performance Test Verification Form" is included at the end of Section 230900. This form (electronic version is available upon request) shall be completed for all mechanical equipment provided under this contract. This shall include, but not be limited to each boiler, air handling unit, fan, pump, DX cooling equipment, miscellaneous heating equipment, etc.

G. Test Report: Upon satisfactory verification of calibration and functional performance tests, a copy of the final test results shall be bound in the operations and maintenance manual. The final report shall also include a

full compliance statement, on company letterhead, indicating that all systems are installed and functioning per the contract requirements including drawings, specifications, control sequences and accepted submittals.

H. The mechanical systems shall not be considered complete until all functional performance verification forms, calibration reports and compliance statement have been submitted and reviewed. Submit in accordance with the submittal requirements indicated elsewhere in these specifications.

1.23 OPERATING AND MAINTENANCE MANUAL

A. Submit Operation and Maintenance Manuals as follows:

1. Provide an electronic version for review by the Owner and A/E, including bookmarks of all section and subsections.

2. After acceptance of the electronic copy, produce hard copies in three-ring binders with each section separated by tab divider. Include protective plastic sleeves for any software or folded large documents submitted. Provide a minimum of two (2) copies to the Owner.

B. At a minimum, the manual shall contain the following:

1. Title page

2. Table of contents

3. Contractor and sub-contractor contact information

4. Supplier contact information for all mechanical equipment

5. Copies of manufacturer's and contractor's warranty information (project and equipment) for all mechanical equipment.

6. Submittal log for all mechanical equipment

7. One (1) reviewed copy of each shop drawing or submittal incorporating all A/E and owner submittal review comments.

8. Copy of inspector acceptance certificates / documents.

9. Provide an 11 x 17 fold-out drawing of each floor plan and indicate locations of the following:

a. System shutoff valves

b. Fire/smoke dampers

10. All duct, pipe and equipment pressure test reports complete with 11 x 17 fold-out drawing, indicating all systems tested.

11. Final Test and Balance (TAB) Reports. Do not include reports that have not been accepted by the A/E. Pencil or partial copies will not be acceptable.

12. Maintenance procedures for each item of mechanical equipment to include frequency and type of maintenance, spare parts and attic/stock list. This shall include the manufacturer's literature indicating operating and maintenance instructions, parts list, illustrations and diagrams.

13. An itemized list of all spare parts and specialty tools shall be transmitted to the Owner.

14. A report of the training procedures and content provided as well as the attendance log.

15. Valve tag chart

16. Mechanical systems functional performance verification forms, calibration reports and compliance statement indicating that all systems are installed and functioning per the contract requirements.

1.24 TOOLS AND LUBRICANTS

A. Furnish and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Owner.

D. Lubricants: A minimum of one quart (.9 L) of oil, and one pound (450 g) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

1.25 FIELD INSTRUCTION

A. Upon completion of work, instruct Owner's representative in the proper operation and maintenance of the mechanical and electrical systems.

B. Instruction periods specified below shall be in addition to instruction specified for certain items elsewhere in the specifications.

C. Instructions shall be given by persons expert in the following systems and equipment and shall include descriptions and demonstration of procedures, data logging, and analysis.

1. Heating Plant - including boilers, burners, pumps, related equipment, water treatment, combustion testing, safety controls. Provide . . hours of instruction.

2. Cooling Plant - Including refrigeration plant, related equipment, safety controls. Provide . . hours of instruction.

3. Air Systems - Including air handling units, heating and cooling coils, filters, fans, safety controls and other air handling equipment. Provide . . hours of instruction.

4. Automatic Control - Including operating controls for all heating, cooling, ventilating systems, control centers, panels. Provide . . hours of instruction.

5. General Instructions - Including review of written operating instructions and balancing report, miscellaneous instructions. Provide . . hours of instruction.

D. Instructions shall be given by persons expert in the operation and maintenance and shall be for a period of not less than . . eight hour days.

E. Prepare statement(s) for signing by Owner's representative indicating date of completion of instructions and hours expended. Furnish copy of signed statement to Engineer.

F. Final mechanical demonstration of all mechanical equipment shall be recorded in DVD compatible format. Provide DVD's to the Owner.

1.26 RECORD DOCUMENTS

A. The Contractor shall maintain a record set of mechanical prints at the project site and shall indicate thereon any changes made to the contract

drawings, including, but not limited to addenda, field sketches, RFI responses, supplemental drawings, sketches, etc. Where changes are made that are reflective of supplemental instructions, revisions, RFI responses, etc., the Contractor shall make clear references to those changes.

B. A separate set of neat, legible mechanical contract prints shall be kept at the project site at all times during the construction of the work for the express purpose of showing any and all changes indicated in paragraph A. above. The prints shall be marked up daily showing all changes to the original documents. The prints shall be marked up in a neat, legible manner using a red pen. Periodic review of the Record Documents will be conducted by the Owner's Representative or A/E. Should this review indicate that the Record Documents are deficient or not up to date, the Contractor shall immediately bring the documents into compliance and make the corrections.

C. Upon completion of the project and before final close-out, the Contractor shall be responsible for producing a final set of record documents in electronic CADD format. One (1) set of full size prints, one (1) CD of the electronic CADD drawings (in AutoCad and pdf format), along with the red-lined marked up field set shall be delivered to the owner upon completion. If requested, the electronic CADD documents shall be up-loaded to the owner's FTP site. The final CADD documents shall indicate in the title or revision block "RECORD DOCUMENTS" along with the date completed. The electronic format shall be compatible with the owner's preferred version of AutoCad. Coordinate with the owner before producing the CD or up-loading to the FTP site. Not acceptable are contractor installation drawings, shop drawings or multi-layers of work on a single drawing. The final as-built product shall mirror the contract bid documents using the project page layout, format and project title block.

D. Computer (CADD) files of mechanical drawings will be made available to the Contractor upon receipt of a signed waiver (available upon request). One CD will be made available to the general contractor or construction manager for distribution to the trades.

E. Should the Contractor's electronic Record Documents not be considered complete, they will be returned for completion and/or correction.

1.27 GUARANTEE/WARRANTY

A. Each Contractor shall furnish a guarantee covering all labor and materials furnished by him for a period of two (2) years from the date of final acceptance of his work, and he shall agree to repair and make good at his own expense any and all defects which may appear in his work during

that time if, in the judgment of the Engineer, such defects arise from defective workmanship and/or imperfect or inferior material.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be delivered to the Owner.

C. Within the two (2) year warranty/guarantee period, manufacturer's recommended maintenance shall be provided by the Contractor.

D. In addition to the warranties indicated above, provide a five (5) year parts and labor warranty for each of the following:

1. All air conditioning unit related compressors (i.e. all air cooled condensing units for VRV systems, split system units, etc.).

1.28 UTILITY REBATE

A. Utility Rebate Application: The mechanical contractor shall provide and submit a utility rebate application to the local utility (BGE Smart Energy Program, or other local utility serving this project area) for the major HVAC equipment (such as packaged A/C units, variable refrigerant flow systems, etc.). The rebate application shall include all information required by the utility company program administrator (ICF International, or other rebate administrator) including, but not limited to, the application, supporting calculations, analysis, comparison of the proposed equipment to baseline equipment or system., etc.; all as defined and/or required by the program administrator. The Owner shall be indicated on the application as the recipient for the full rebate.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION

SECTION 23 0200 - PROJECT CLOSEOUT HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This section provides a summary of the primary mechanical project closeout activities, however, this section does not attempt to address all project closeout requirements. Closeout activities referenced in this section include the following:

1. Pressure Testing
2. Start-up
3. Punch-out Procedures
4. Testing, Adjusting and Balancing
5. Functional Performance Testing and Verification
6. Operation and Maintenance Manuals (O & M Manuals)
7. Demonstration and Training
8. Record Documents
9. Close-out Documents

B. This Section shall not supersede any other close-out section or requirements of the Contract. Refer to other Divisions of the specifications and the General Requirements of the Contract for further instructions.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PRESSURE TESTING

A. Piping: The Contractor shall perform pressure testing on all piping systems

as indicated in Division-23 section "Testing, Adjusting and Balancing", and elsewhere as indicated.

B. Ductwork: The Contractor shall perform pressure testing on all ductwork systems as indicated in Division-23 sections, "Testing, Adjusting and Balancing", "Low Pressure Ductwork" and elsewhere as indicated.

C. Air Handling Units: The Contractor shall perform factory and / or field pressure testing on all air handling units where required by the drawings or specifications.

D. Final pressure test results shall be submitted as a separate project submittal for review and included with the Test and Balance Report. Upon review for general conformance, include all pressure tests in the O & M Manual.

E. All factory performed equipment test results shall be included in the final O & M Manuals.

F. Where re-tests were required, indicate remedial action taken and submit in test report.

3.2 START-UP

A. The Contractor shall perform start-up on each piece of mechanical equipment as specified in each section of Division-23.

B. Where indicated in each section of Division-23, the services of a factory authorized and certified technician shall be required to perform the equipment start-up. Start-up by any other organization other than as required by the manufacturer is unacceptable.

C. Start-up reports shall be provided for all equipment and be included in the final O & M Manuals.

3.3 PUNCH-OUT PROCEDURES

A. Preliminary Punch-out:

1. Prior to requesting an inspection from the Owner, Engineer, or Permit Official, the General Contractor or Construction Manager (GC or CM) shall provide a preliminary punch-out of the area in question.

2. Once completed, their punch list shall be supplied to each trade for corrections and completion. The punch list shall also be provided to the Engineer for their use.

3. Upon being informed that the trade contractors have addressed all of the outstanding items, the GC / CM shall backcheck the work and update the punch list.

B. Final Punch-out:

1. Final punch-out by the engineer shall not commence until the GC or CM has exhausted their review and has signed off on all items.

2. A copy of the sign-off shall be provided to the Engineer for their record.

3. Once the above has been completed, the Engineer shall be notified that the work is substantially complete and ready for a final punch-out.

4. Depending on the size, schedule, and project complexity, punch-outs may be requested for specific areas or systems, rather than the facility as a whole. Examples of specific requests include the following:

a. Above ceiling

b. Mock-ups for any repetitive installation to confirm acceptance prior to continuing (labs, dorms, offices, etc.)

c. Equipment rooms

C. Upon completion of any and all punch lists (i.e. above ceiling, final, partial, phased, factory review, or specific item) the contractor shall provide an item by item sign-off indicating the date and who completed the item. The sign-off shall be submitted to the A/E and owner before final payment is processed. Should the contractor disagree with any item, they shall provide a written exception giving reason for review.

3.4 TESTING, ADJUSTING AND BALANCING

A. Comply with all provisions of Division-23 Section, "Testing, Adjusting and Balancing" (TAB) for the systems listed, but not limited to, the following:

1. Building Automated Systems

2. Fans

3. Air Handling Units

4. Ductwork Systems

5. Pumps

6. Coils

7. Boilers

8. Piping Systems

9. Terminal Units

B. TAB reports shall be submitted as a separate project submittal for review. Upon review for general conformance, include the final TAB report in the O & M Manual.

C. Comply with testing, adjusting and balancing requirements as indicated in each section within Division-23.

3.5 FUNCTIONAL PERFORMANCE TESTING AND VERIFICATION

A. General: In addition to the tests required during and after installation of all mechanical systems, as well as any other formal commissioning requirements, the Contractor shall perform functional performance tests to verify that all systems are designed, installed, calibrated and adjusted to perform as required in the Contract.

B. Comply with all applicable specification sections including, but not be limited to, "Basic HVAC Requirements", "Testing, Adjusting and Balancing", "Automatic Temperature Controls" and "Commissioning", where applicable.

C. Prior to functional performance testing, all indicating, recording and control devices shall be calibrated. A calibration verification report shall be provided with the final test report.

D. Provide functional performance testing to verify proper operation of each and every control sequence indicated throughout the contract documents.

E. Failure of Tests: Should any test, verification, or demonstration fail to meet the specification requirements, the component of the system causing the failure shall be repaired, replaced or readjusted. The failed test, verification, or demonstration shall then be repeated.

F. A "Functional Performance Test Verification Form" is included at the end of Section 230900. This form (electronic version is available upon request) shall be completed for <u>all</u> mechanical equipment provided under this

contract. This shall include, but not be limited to each boiler, air handling unit, fan, pump, DX cooling equipment, miscellaneous heating equipment, etc.

G. Test Report: Upon satisfactory verification of calibration and functional performance tests, a copy of the final test results shall be bound in the operations and maintenance manual. The final report shall also include a full compliance statement, on company letterhead, indicating that all systems are installed and functioning per the contract requirements including drawings, specifications, control sequences and accepted submittals.

H. The mechanical systems shall not be considered complete until all functional performance verification forms, calibration reports and compliance statement have been submitted and reviewed. Submit in accordance with the submittal requirements indicated elsewhere in these specifications.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Submit Operation and Maintenance Manuals as follows:

1. Provide an electronic version for review by the Owner and A/E, including bookmarks of all section and subsections.

2. After acceptance of the electronic copy, produce hard copies in three-ring binders with each section separated by tab divider. Include protective plastic sleeves for any software or folded large documents submitted. Provide a minimum of two (2) copies to the Owner.

B. At a minimum, the manual shall contain the following:

1. Title page

2. Table of contents

3. Contractor and sub-contractor contact information

4. Supplier contact information for all mechanical equipment

5. Copies of manufacturer's and contractor's warranty information (project and equipment) for all mechanical equipment.

6. Submittal log for all mechanical equipment

7. One (1) reviewed copy of each shop drawing or submittal

incorporating all A/E and owner submittal review comments.

8. Copy of inspector acceptance certificates / documents.

9. Provide an 11 x 17 fold-out drawing of each floor plan and indicate locations of the following:

   a. System shutoff valves

   b. Fire/smoke dampers

10. All duct, pipe and equipment pressure test reports complete with 11 x 17 fold-out drawing, indicating all systems tested.

11. Final Test and Balance (TAB) Reports. Do not include reports that have not been accepted by the A/E. Pencil or partial copies will not be acceptable.

12. Maintenance procedures for each item of mechanical equipment to include frequency and type of maintenance, spare parts and attic/stock list. This shall include the manufacturer's literature indicating operating and maintenance instructions, parts list, illustrations and diagrams.

13. An itemized list of all spare parts and specialty tools shall be transmitted to the Owner.

14. A report of the training procedures and content provided as well as the attendance log.

15. Valve tag chart

16. Mechanical systems functional performance verification forms, calibration reports and compliance statement indicating that all systems are installed and functioning per the contract requirements.

3.7 DEMONSTRATION AND TRAINING

A. Upon completion of work, instruct the owner's representative in the proper operation and maintenance of each mechanical system in accordance with applicable specification sections.

B. Instructions shall be given by persons expert in the operation and maintenance of each system / equipment.

C. Prepare statement(s) for signing by Owner's representative indicating the date of completion of instructions and hours expended. Furnish copies of

signed statements to the A/E.

D. Final demonstration of all mechanical equipment shall be recorded in DVD compatible format.

1. The recordings shall be organized systemically from largest to smallest component.

2. The recordings shall include bookmarks to reference each type of equipment, all major components, and each component requiring regular maintenance.

3. No segment shall be unannotated longer than fifteen minutes.

4. Submit a digital link of the draft for review by the owner and A/E.

5. Submit two hardcopy DVDs of the final approved copy to the owner's representative.

6. Submit a digital link of the final approved copy to the owner's representative.

3.8 RECORD DOCUMENTS

A. The Contractor shall maintain a record set of mechanical prints at the project site and shall indicate thereon any changes made to the contract drawings, including, but not limited to addenda, field sketches, RFI responses, supplemental drawings, sketches, etc. Where changes are made that are reflective of supplemental instructions, revisions, RFI responses, etc., the Contractor shall make clear references to those changes.

B. A separate set of neat, legible mechanical contract prints shall be kept at the project site at all times during the construction of the work for the express purpose of showing any and all changes indicated in paragraph A. above. The prints shall be marked up daily showing all changes to the original documents. The prints shall be marked up in a neat, legible manner using a red pen. Periodic review of the Record Documents will be conducted by the Owner's Representative or A/E. Should this review indicate that the Record Documents are deficient or not up to date, the Contractor shall immediately bring the documents into compliance and make the corrections

C. Upon completion of the project and before final close-out, the Contractor shall be responsible for producing a final set of record documents in electronic CADD format. One (1) set of full size prints, one

(1) CD of the electronic CADD drawings (in AutoCad and pdf format), along with the red-lined marked up field set shall be delivered to the owner upon completion. If requested, the electronic CADD documents shall be up-loaded to the owner's FTP site. The final CADD documents shall indicate in the title or revision block "RECORD DOCUMENTS" along with the date completed. The electronic format shall be compatible with the owner's preferred version of AutoCad. Coordinate with the owner before producing the CD or up-loading to the FTP site. Not acceptable are contractor installation drawings, shop drawings or multi-layers of work on a single drawing. The final as- built product shall mirror the contract bid documents using the project page layout, format and project title block.

D. Computer (CADD) files of mechanical drawings will be made available to the Contractor upon receipt of a signed waiver (available upon request). One CD will be made available to the general contractor or construction manager for distribution to the trades.

E. Should the Contractor's electronic Record Documents not be considered complete, they will be returned for completion and/or correction.

3.9 CLOSEOUT DOCUMENTS

A. Prior to Substantial Completion and /or Final Payment, the Contractor shall prepare and submit the following:

1. Final punch lists indicating completion of all items
2. All record drawings
3. All record specifications
4. Operation and Maintenance Manuals
5. Complete final cleaning
6. Remove temporary facilities and complete site restoration

END OF SECTION

SECTION 23 0500 - BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

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

B. Requirements specified in Division-23 Section "Basic HVAC Requirements" apply to this Section.

1.2 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:

1. Mechanical equipment nameplate data.

2. Firestopping: Provide seals for all openings (new and existing) through fire-rated walls, floors, or ceilings used as passage for mechanical and electrical components such as piping, ductwork, conduit, etc.

3. Miscellaneous metals for support of mechanical materials and equipment.

4. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.

5. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.

6. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.

1.3 DEFINITIONS

A. The following definitions apply to firestopping:

1. Assembly: Particular arrangement of materials specific to given type

of construction described or detailed in referenced documents.

2. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.

3. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gases and smoke.

4. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

5. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, at wall tops between top of wall and ceiling, and structural floors or roof decks; and gaps between adjacent sections of structural floors.

6. System: Specific products and applications classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

7. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division-01 Specification Sections.

B. Product data for the following products:

1. Access panels and doors

2. Joint sealers

C. Firestopping: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures.

1. Provide details of each proposed assembly identifying intended products and applicable UL system number, or UL classified devices.

2. Provide drawings relating to non-standard applications as needed.

D. Shop drawings detailing fabrication and installation for metal

fabrications, and wood supports and anchorage for mechanical materials and equipment.

E. Coordination drawings for access panel and door locations in accordance with Division-23 sections.

F. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.

G. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an Installer for the installation and application of joint sealers, access panels and doors, and firestopping materials with at least two years' experience with installations.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

1. Provide UL Label on each fire-rated access door.

D. Local and State Regulatory Requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL firestop system numbers, or UL classified devices.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and

damage.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS

2.1 MECHANICAL EQUIPMENT NAMEPLATE DATA

A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.2 FIRESTOPPING

A. All penetrations through fire barriers (new and existing) shall be firestopped with an approved material that is capable of maintaining the fire resistance rating of the barrier. All firestop sealants shall conform to ASTM E 814, ASTM E 119, UL 1479, UL 2079 CAN/ULC S115, and CAN/ULC S101.

B. Firestop material shall be latex based, intumescent caulk intended for use for all thru-penetrations with piping, ducts, cable trays, conduit, and cables.

C. When exposed to high temperatures or fires, the caulk shall expand in volume to quickly close off voids left by melting or burning construction materials. Caulk shall be applied by a standard caulk gun and remain flexible after curing.

D. Acceptable products shall be limited to Johns Manville "Firetemp-C1;" Hilti "FS-One;" or 3M "CP25WB+." Coordinate with General Contractor such that a single manufacturer/ product is utilized throughout the project for all fire and smoke stopping materials.

2.3 SMOKE STOPPING

A. All penetrations through smoke barriers, smoke partitions, or any other

surface required to resist the passage of smoke (new and existing) shall be provided with a smoke stop sealant and/or system that has been independently tested to provide an acceptable smoke seal that will resist the passage of smoke. Smoke stop systems (including product and installation) shall conform to all applicable standards (including but not limited to ASTM, UL and NFPA), as well as all other local, state or federal requirements.

B. Acceptable manufacturers shall be limited to the manufacturers that may provide firestopping materials/systems (see paragraph 2.02 of this section). Coordinate with the General Contractor such that a single manufacturer/product is utilized throughout the project for all fire and smoke stopping materials.

2.4 SOIL MATERIALS

A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch (40 mm) sieve, and not more than 5 percent passing a No. 4 sieve.

C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches (150 mm) in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

2.5 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout, recommended for interior and exterior applications.

F. Fasteners: Zinc-coated, type, grade, and class as required.

2.6 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches (12 mm).

2.7 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.

2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with non-porous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.

D. Acrylic-Emulsion Sealants: One-part, non-sag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire rated walls and floors. Sealants and accessories shall have fire resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E

814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.8 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage (1.6 mm) steel, with a 1-inch (25 mm) wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

1. For Installation in Masonry, Concrete, Ceramic Tile, or Wood Paneling: 1-inch (25 mm) wide exposed perimeter flange and adjustable metal masonry anchors.

2. For Gypsum Wallboard or Plaster: Perforated flanges with wallboard bead.

3. For Full-Bed Plaster Applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

C. Flush Panel Doors: 14-gage (2 mm) sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees (3.05 Radians); factory-applied prime paint.

1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

D. Locking Devices: Flush, screwdriver-operated cam locks. [Common use]

E. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide two (2) keys. [Secured areas only: note as such].

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 installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory

conditions have been corrected.

3.2 FIRESTOP INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

B. Seal new and existing holes or voids made by penetrations to ensure an effective smoke barrier.

C. Where floor openings without penetrating items are more than four inches (100 mm) in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.

D. Protect materials from damage on surface subject to traffic.

E. Place firestopping in annular space around fire dampers before installation of damper's anchoring flanges which are installed in accordance with fire damper manufacturer's recommendations.

F. Where large openings are created in walls or floors to permit installation of pipes, ducts, cable tray, bus duct or other items, close unused portions of opening with firestopping material tested for the application.

G. Install smoke stopping as specified for firestopping (new and existing).

H. Where rated walls are constructed with horizontally continuous air space, double width masonry, or double stud frame construction, provide vertical, 12 inch (300 mm) wide fiber dams for full thickness and height of air cavity at maximum 15 foot (4500 mm) intervals.

3.3 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.6 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.

2. Comply with recommendations of ASTM C 790 for use of acrylic - emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 INSTALLATION OF ACCESS DOORS

A. Provide access doors (minimum 18" x 18") as required to provide maintainable access to all mechanical equipment including, but not limited to, valves, dampers, air terminals, etc.

B. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

END OF SECTION

SECTION 23 0513 - ELECTRICAL PROVISIONS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electrical provisions to be provided as mechanical work is indicated in all other Division-23 sections, on drawings, and as further specified in this section.

B. Types of work normally recognized as electrical, but provided as mechanical, specified or partially specified in this section, include but are not necessarily limited to the following:

1. Motors for mechanical equipment.

2. Motor starters and Variable Frequency Drives (VFDs) for mechanical equipment.

3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.

4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.

5. Electrical heating coils and similar elements in mechanical equipment.

C. Refer to requirements of Division-26 sections.

1.2 QUALITY ASSURANCE

A. Coordination with Electrical Work: Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division-26 sections for electrical work of this section which is not otherwise specified.

B. Standards: For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology herein. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.3 SUBMITTALS

A. Listing, Motors of Mechanical Work: Concurrently, with submittal of mechanical products listing (Basic Mechanical and Division-1 requirements), submit separate listing showing rating, power characteristics, application (connected equipment), and general location of every motor to be provided with mechanical work. Submit updated information promptly when and if initial data is revised.

1. Include in listing of motors, notations of whether motor starter is furnished or installed integrally with motor or equipment containing motor.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Characteristics: Except where more stringent requirements are indicated, and except where required item of mechanical equipment cannot be obtained with fully complying motor, comply with the following requirements for motors of mechanical work:

B. Temperature Rating: Rated for 113 degrees F (40 degrees C) environment with maximum 122 degrees F (50 degrees C) temperature rise for continuous duty at full-load (Class B Insulation).

C. Starting Capability: Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than five (5) starts per hour for manually controlled motors.

D. Phases and Current Characteristics: Provide squirrel cage induction polyphase motors for 1/2 hp (.4 kW) and larger, and provide capacitor-start single-phase motors for 1/3 hp (.25 kW) and smaller, except 1/6 hp (.1 kW) and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division-26 sections, and with individual equipment requirements specified in other Division-23 requirements. For 2-speed motors provide two (2) separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.

E. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

F. Motor Construction: Provide general purpose, continuous duty motors,

Class F insulation, Design "B" except "C" where required for high starting torque.

1. Bearings: Ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division-23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.

2. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division-23 for other enclosure requirements.

3. Overload Protection: Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.

4. Noise Rating: Provide industry standard "Quiet" rating on motors.

5. Efficiency: For motors 1 horsepower (.7 kW) or higher, provide motors with minimum efficiencies as follows in accordance with IEEE Standard 112, Test Method B:

   a. Enclosed Motors (TEFC)

MOTOR HP (KW)	MINIMUM EFFICIENCY *		
	1200 RPM	1800 RPM	3600 RPM
1 (.7)	82.5%	85.5%	77.0%
1.5 (1.1)	87.5%	86.5%	84.0%
2 (1.5)	88.5%	86.5%	85.5%
3 (2.2)	89.5%	89.5%	86.5%
5 (4)	89.5%	89.5%	88.5%
7.5 (5.6)	91.0%	91.7%	89.5%

* Required Full Load Nominal Efficiency shall be in accordance with EISA 2007. Where efficiency listed above is higher than the EISA 2007 requirement, provide the higher efficiency indicated.

b. Where fan or pump motors are used in conjunction with, or controlled by, a variable frequency drive (VFD), motors shall be suitable for VFD operation (inverter duty motors).

c. For motors less than 1 horsepower (.7 kW), provide motors with higher efficiency than "average standard industry motors," in accordance with IEEE Standard 112, test method B.

G. Nameplate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, special feature and similar information.

H. Motor Modifications: In cases where the equipment submitted requires additional motors and/or controls, circuiting and related equipment shall be provided as approved and in accordance with the National Electrical Code. All costs relative to these electrical changes shall be included under the Section in which the equipment is furnished and installed and shall be coordinated with the electrical work at no expense to the Owner.

I. Power Factor: All motors one (1) horsepower and above shall have a minimum power factor of 0.90.

J. All motors operated on variable frequency drives shall be equipped with a maintenance free, conductive microfiber, shaft grounding ring with a minimum of two (2) rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings. Motors up to 100 HP shall be provided with a minimum of one (1) shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor pump manufacturer or contractor and shall be installed in accordance with the manufacturer's recommendations.

2.2 MOTOR STARTERS AND VARIABLE FREQUENCY DRIVES (VFDS)

A. Where motor starters and/or variable frequency drives (VFDs) are indicated for mechanical equipment, they shall comply with all requirements outlined with the electrical specifications for motor starters and VFDs. Where motor starters and/or VFDs are provided by the mechanical contractor, or as a portion of a packaged mechanical unit, the electrical specifications shall also apply. All VFDs for the project,

whether provided by the mechanical or electrical contractor, shall be provided by a single manufacturer, and shall include the same features and options.

2.3 MECHANICAL EQUIPMENT

A. Electrical Heating Elements: Where electrical resistance coils and other heating elements are included in mechanical equipment or otherwise indicated as mechanical work, and except as otherwise indicated, provide 120-volt units where rating is less than 2 kW, higher-voltage single phase units where rating is 2 kW but less than 5 kW, and higher-voltage 3-phase units where rating is 5 kW and greater.

B. All mechanical equipment shall be approved and listed by Underwriters' Laboratories (UL) and shall bear nameplate indicating same.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp (.25 kW) and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Deliver starters and wiring devices which have not been factory installed on equipment unit to electrical Installer for installation.

C. Install furnished under Division-26 starter panels and wiring devices at locations indicated, securely supported and anchored, and in accordance with manufacturer's installation instructions. Locate in accordance with National Electric Code for installation requirements.

END OF SECTION

SECTION 23 0519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of meters and gauges required by this section is indicated on drawings and/or specified in other Division-23 sections.

B. Types of meters and gauges specified in this section include the following:

1. Temperature Gauges and Fittings:
    a. Direct Mount Dial Thermometers
    b. Remote Reading Dial Thermometers
    c. Thermometer Wells
2. Pressure Gauges and Fittings:
    a. Pressure Gauges
    b. Pressure Gauge Cocks
    c. Pressure Gauge Connector Plugs
    d. Magnehelic Pressure Gauges
3. Flow Measuring Meters:
    a. Flow Meter Fittings
    b. Flow Measuring Readout Kit
    c. Permanently Mounted Flow Meters
    d. BTU Meters

C. Meters and gauges furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division-23 sections.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.

2. ANSI and ISA Compliances: Comply with applicable portions of American National Standards Institute (ANSI) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

B. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge. Include this data in Maintenance Manual.

PART 2 - PRODUCTS

2.1 DIRECT MOUNT DIAL THERMOMETERS

A. General: Provide direct mount dial thermometers of materials designed and constructed for use in service indicated.

B. Type: Vapor tension, universal angle.

C. Case: Drawn steel or brass, glass lens, 5" (125 mm) diameter. For gauges mounted above eight feet (2400 mm), 8" (200 mm) diameter gauge.

D. Adjustable Joint: Die cast aluminum, 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal plane, with locking device.

E. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube, one scale division accuracy.

F. Movement: Brass precision geared.

G. Scale: Progressive, satin faced, non-reflective aluminum, permanently

etched markings.

H. Stem: Copper plated steel, or brass, for separable socket, length to suit installation.

I. Range: Conform to the following:

1. Hot Water: 30°F - 240°F (-1°C - 116°C).

2. Air: 40°F - 160°F (4°C - 71°C).

2.2 REMOTE READING DIAL THERMOMETERS

A. General: Provide remote reading dial thermometers of materials designed and constructed for use in service indicated.

B. Type: Vapor tension.

C. Case: Drawn steel or brass, glass lens, 5" (125 mm) diameter. For gauges mounted above eight feet (2400 mm), 8" (200 mm) diameter shall be used.

D. Movement: Brass, precision geared.

E. Tubing: Bronze double braided armor over copper capillary, length to suit installation.

F. Bulb: Copper with separable socket for liquids, averaging element for air.

G. Accuracy: ± one scale division.

H. Range: Conform to the following:

1. Hot Water: 30°F - 240°F (-1°C - 116°C).

2. Air: 40°F - 160°F (4°C - 71°C).

2.3 THERMOMETER WELLS

A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" (50 mm) extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

B. Manufacturer: Same as thermometers.

2.4 PRESSURE GAUGES

A. General: Provide pressure gauges of materials designed and constructed for use in service indicated.

B. Type: General use, 1% accuracy, ANSI B 40.1 Grade A, phosphor bronze bourdon type, bottom connection.

C. Case: Drawn steel or brass, glass lens, 5" (125 mm) diameter. For gauges mounted above eight feet (2400 mm), 8" (200 mm) gauges shall be used.

D. Connector: Brass with 1/4" (6 mm) male NPT. Provide protective syphon when used for steam service.

E. Scale: White coated aluminum, with permanently etched markings.

F. Range: Conform to the following:

1. Water: 0 - 100 psi (0 - 690 kPa).

2.5 PRESSURE GAUGE COCKS

A. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Construct gauge cock of brass with 1/4" (6 mm) female NPT on each end, and "T" handle brass plug.

B. Syphon: 1/4" (6 mm) straight coil constructed of brass tubing with 1/4" (6 mm) male NPT on each end.

C. Snubber: 1/4" (6 mm) brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

D. Manufacturer: Same as for pressure gauges.

2.6 PRESSURE GAUGE CONNECTOR PLUGS

A. General: Provide pressure gauge connector plugs pressure rated for 500 psi (3448 kPa) and 200˚F (93˚C). Construct of brass and finish in nickel plate, equip with 1/2" (13 mm) NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" (3 mm) O.D. probe assembly from dial type insertion pressure gauge. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

2.7 MAGNEHELIC PRESSURE GAUGES

A. Provide direct reading magnehelic gauges indicating pressure drop across each filter assembly. The inlet and outlet of filter assembly shall be provided with remote dial type gauges of suitable ranges.

2.8 FLOW METER FITTINGS

A. Furnish and install venturi flow metering elements at each balancing valve location indicated on plans and drawings. Elements 2" (50 mm) and smaller shall be constructed of brass with threaded connections, 2-1/2" (65 mm) and larger shall be constructed of steel with butt weld or flanged connections.

B. Each primary element shall be selected to permit the design flow rate to fall between 20% to 80% of the full range on the linear scale of the meter. The permanent pressure loss shall not exceed 10% of the indicated flow rate differential.

C. The accuracy shall be ±3% of flow rate in the flow range indicated on the tabulation as verified by a recognized Independent Laboratory specializing in the research, testing and application of fluid meters, valves and hydraulics.

D. Each element shall be complete with instrument shut-off valves each with quick disconnect connections and identification tag with a chain, pressure rated to 300 psi (2069 kPa), temperature rated to 250°F (121°C).

E. Flow meter fittings shall be as manufactured by Preso, Flow Design or Flowset.

2.9 FLOW MEASURING READOUT KIT

A. Provide portable flow meters with bellows type differential pressure element and minimum 5" (125 mm) diameter indicating dial.

B. Design pressure elements for full scale pressure differential of 50" or 100" water gauge (12.4 kPa or 24.9 kPa). Design shall incorporate rupture-proof metal beryllium or stainless steel bellows and torque tube drive requiring no lubrication. Design forged bodies for not less than 150% of maximum surge pressure, fully protected against surges, with full provision for venting and draining. Provide integral, adjustable pulsation dampers.

C. Dials of portable meters shall have square root scales not less than 12" (300 mm) in developed length. Dials shall read from 0 to 10 gpm (0 to .6

L/s) to which multiplier is to be applied, as required; also provide with uniform scale reading from 0" to 10" w.g. (0 kPa to 2.5 kPa), to which multiplier of 10 is to be applied (100" at full scale) (2.5 m at full scale), or from 0" to 5" w.g. (0 kPa to 1.2 kPa), to which multiplier of 10 is to be applied (50" at full scale) (2.5 m at full scale).

D. Engineer and manufacture in accordance with ASME recommendations for flow meters. Provide portable meters with overall accuracy of ± 5%.

E. Provide flow meter with factory-fabricated carrying case with integral carrying handle. Case shall be fitted to hold meter and following accessories:

1. Two 10' (3 m) lengths of connecting hose with suitable female connectors for connecting to venturi tube pressure tap nipples. Design hose for operating pressure of minimum of 150% of maximum system operating pressure.

2. Completely assembled 3-valve manifold with 2 block valves and vent and drain valves shall be piped and mounted on base, which shall be designed for use laying flat on stationary base.

3. Bound set of descriptive bulletins, installation and operating instructions, parts list, and set of curves showing flow verses pressure differential for each orifice or venturi tube with which meter is to be used.

4. Metal instruction plate, secured inside cover, illustrating use of meter. Deliver meter with case to Owner.

2.10 PERMANENTLY MOUNTED FLOW METERS

A. Provide permanently mounted meters consisting of bellows type differential pressure element and either indicating or recording and integrating element as noted in schedule or indicated on drawings.

B. Differential pressure elements and indicating or recording and integrating elements generally shall be direct-connected, but pneumatic electric or electronic transmission elements shall be used when particular installation precludes use of direct-connected units. Pneumatic, electric or electronic transmission elements shall be provided wherever pressure-sensing lines required for, direct transmission would exceed 150' (45 m) in length or cannot be graded properly. Connect each flow meter to primary element as specified and provide with all piping, wiring, and accessories required for complete installation. Provide flow metering equipment supplied by single manufacturer or coordinated by single

supplier.

C. Permanently mounted meter installations (primary flow measuring element and flow meter) shall have overall accuracy of +2% of full scale flow over range of 20% to 100%of full scale flow. Engineer and manufacture primary elements of meters in accordance with ASME recommendations for flow meters.

D. Design bellows type differential pressure elements (meter bodies) for full scale pressure differential of 50" w.g. to 100" w.g. (12.5 kPa to 25 kPa). Design shall incorporate rupture-proof stainless steel or copper metal bellows and torque tube drive requiring no lubrication. Design forged meter bodies for not less than 150% of maximum system pressure and fully protect against surges, with provision for venting and draining. Provide meter bodies with integral, adjustable pulsation dampers.

E. Provide meter with complete copper tubing connections of approved sizes between differential pressure elements (meter bodies) and venturi tubes. Include necessary vent and drain valves as recommended by meter manufacturer.

F. Dials shall be flush type reading directly in gallons per minute.

G. Enclose recordings and integrating elements of each recording and integrating meter in dust-tight case. Arrange case for flush panel mount. Elements shall record flow continuously on 7 day, 12" (300 mm) diameter, linear chart. Integrators shall be of 7 figure direct reading type with either 15-second or continuous operating cycle. Furnish one-year supply of charts, pens and ink for each meter and deliver to Owner.

H. Design remote transmitters and receivers so that normal changes in air supply system pressure or in electric power supply system voltage or frequency will not affect accuracy of meters. Measuring circuits shall be relieved of all work required to move mechanical parts.

2.11 BTU METERS

A. General: Provide BTU meters as indicated, pressure rated for 125 psi (850 kPa), consisting of turbine wheel flow meter, bronze housing, solid state calculator with internal battery pack, two (2) temperature sensors (one with 5' cable) (one with 1.5 m cable), integral stop valves on inlet and outlet, strainer, and magnetic trap.

B. Temperature Range: 40°F - 250°F (4°C - 121°C).

C. Power Input: 12 month operating life battery pack.

D. Data Output: 6-digit electromechanical counter with readout in kwh or btu.

E. Accuracy: ± 1% over range of 1 - 12 gpm (.061 L/s to .76 L/s); ± 1% of temperature difference of 5˚F (2.8˚C) and greater.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TEMPERATURE GAUGES

A. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor.

B. Locations: Install direct mounted thermometers in the following locations, and elsewhere as indicated:

1. At inlet and outlet of each hydronic zone.

2. At inlet and outlet of each hydronic boiler.

3. At supply and return piping for heating water from central plant.

4.

5. At suction and discharge of each hydronic pump.

6. At inlet and outlet of each thermal storage tank.

7. Supply, return, fresh air for each air handling unit.

C. Remote Reading Dial Thermometers: Install on control panels as indicated. Run tubing between panel and thermometer bulb, adequately supported to prevent kinks. Select tubing length so as to not require coiling of tubing.

D. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical upright position. Fill well with oil or graphite, secure cap.

3.3 INSTALLATION OF PRESSURE GAUGES

A. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated:

1. At suction and discharge of each pump.

2. At inlet and outlet of each pressure reducing valve.

3. At inlet and outlet of large strainers.

4. At supply and return piping for heating water from central plant.

5. At inlet of expansion tanks.

6. At inlet and outlet of water filtration systems.

C. Pressure Gauge Cocks: Install in piping tee with snubber. Install syphon for steam pressure gauges.

D. Pressure Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.4 INSTALLATION OF PERMANENTLY MOUNTED FLOW METERS

A. General: Install flow measuring meters on piping systems as indicated.

3.5 INSTALLATION OF BTU METERS

A. General: Install in piping where indicated, in hydronic supply line. Provide thermal well in return line for remote sensor. Mount meter on wall if accessible, if not provide bracket to support meter.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows and repair any scratched or marred surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 0523 - VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of valves required by this section is indicated on drawings and/or specified in other Division-23 sections.

B. Types of valves specified in this section include the following:

1. Gate Valves
2. Globe Valves
3. Drain Valves
4. Ball Valves
5. Butterfly Valves
6. Check Valves

C. System Descriptions:

1. HVAC Piping: HVAC piping shall relate to chilled water, heating water, condenser water and glycol systems.

D. Valves furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division-23 sections.

1.2 QUALITY ASSURANCE

A. Valve Types: Provide valves of same type by same manufacturer.

B. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating and size clearly marked on valve body.

C. Codes and Standards:

1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".
2. ANSI Compliance: For face-to-face and end-to-end dimensions of

flanged or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve.

B. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of valve. Include this data, product data, and shop drawings in Maintenance Manual.

PART 2 - PRODUCTS

2.1 VALVES - GENERAL

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work, shall be limited to the following, unless otherwise noted:

1. Milwaukee
2. Bray
3. Apollo
4. DeZurik
5. Jamesbury
6. Watts

B. Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

C. Size: Unless otherwise indicated, provide valves of same size as upstream pipe size. Pipe size reduction shall be made after valve assembly.

D. Valve Features: Provide the following as required:

1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.

2. Bypass: Comply with MSS SP-45, and except as otherwise indicated, provide manufacturer's standard bypass piping and valving.

3. Drain: Comply with MSS SP-45, and provide threaded pipe plugs.

4. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5, (steel), or ANSI B16.24 (bronze).

5. Threaded: Valve ends complying with ANSI B2.1.

6. Butt-Welding: Valve ends complying with ANSI B16.25.

7. Socket-Welding: Valve ends complying with ANSI B16.11.

8. Solder-Joint: Valve ends complying with ANSI B16.18.

9. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

10. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6" (150 mm) and smaller. Provide gear operators for quarter-turn valves 8" (200 mm) and larger. Provide chain-operated sheaves and chains for overhead valves as indicated.

2.2 GATE VALVES

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-70.

2. Bronze Valves: MSS SP-80.

3. Steel Valves: ANSI B16.34.

2.3 GLOBE VALVES

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-85.

2. Bronze Valves: MSS SP-80.

3. Steel Valves: ANSI B16.34.

B. HVAC Piping:

1. 2" (50 mm) and Smaller: Class 150, bronze body, union bonnet, integral seat, renewable TFE disc. Milwaukee Model 590T (Threaded), 1590T (Sweat) or equivalent.

2. Flanged Ends; 2-1/2" (65 mm) and Larger: Class 125, iron body, bolted bonnet, renewable seat and disc, bronze mounted. Milwaukee Model F2981A or equivalent.

2.4 DRAIN VALVES

A. HVAC Piping:

1. 3" (75 mm) and Smaller: Class 125, bronze body ball valve with chrome plated ball, hose end with cap and chain. Milwaukee BA100H (Threaded), Milwaukee BA150H (Sweat) or equivalent.

2.5 BALL VALVES

A. Comply with the following standards:

1. Bronze Valves: MSS SP-110.

2. Potable Water: NSF-61-8.

B. HVAC Piping:

1. 2" (50 mm) and Smaller: Valves shall be rated 150 psi (1035 kPa) SWP and 600 psi (4140 kPa) non-shock WOG and shall have 2-piece cast ASTM B 584 bronze bodies, TFE seats, standard port, separate packing nut with adjustable stem packing, anti-blowout stems and stainless steel ball. Valve ends shall have full depth ANSI threads or extended solder connections and be manufactured to comply with MSS-SP110. Milwaukee BA100S (Threaded), BA150S (Sweat) or equivalent with NSF compliance for potable water.

C. Where piping is insulated, ball valves shall be equipped with 2" (50 mm) extended handles of non-thermal conductive material. Also, provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.

2.6 BUTTERFLY VALVES

A. General: Comply with MSS SP-68. Where butterfly valves are used as shutoffs for terminal or equipment removal or repair, select bubble tight, lug body type valves suitable for dead end service.

B. HVAC Piping:

1. 2-1/2 " (65 mm) to 6" (150 mm): 150 psi (1035 kPa), carbon steel or 316 stainless steel body, extended neck, 316 stainless steel disc, single piece RPTFE seat with stainless steel spring insert, self-lubricating bearings, double shaft and manual lever and lock. Milwaukee Model HP1LCS4212 or equivalent.

2. 8" (200 mm) and Larger: 150 psi (1035 kPa), carbon steel or 316 stainless steel body, extended neck, 316 stainless steel disc, single piece RPTFE seat, self-lubricating bearings, double offset shaft, manual lever and lock and gear operator. Milwaukee Model HP1LCS4213 or equivalent.

3. All valves shall be capable of bubble tight dead end service in either direction without use of additional pinning, screws or mating flanges.

4. Valves shall have pressure energized type seats of RPTFE with seat energizing insert. EPDM rubber seats are not acceptable. Seats shall be field replaceable.

5. Provide packing gland with "V" type ring packing, externally adjustable. Packing gland, nuts and studs shall be constructed of stainless steel.

2.7 CHECK VALVES

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-71.

2. Bronze Valves: MSS SP-80.

3. Steel Valves: ANSI B16.34.

B. HVAC Piping:

1. 2" (50 mm) and Smaller: Class 150, bronze body, horizontal swing, T pattern with renewable TFE disc. Milwaukee 510T (Threaded), 1510T (Sweat) or equivalent.

2. 2-1/2" (65 mm) and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Milwaukee F2974A or equivalent.

2.8 BALANCE VALVES

A. HVAC: See Division-23 section "Hydronic Specialties" for HVAC balance valve specification, however all valves shall meet the requirements of this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Except as otherwise indicated, comply with the following requirements.

1. Install valves where required for proper operation of piping and equipment, including valves in branch lines, service mains and all equipment connections. Locate valves so as to be accessible and so that separate support can be provided when necessary.

2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Mechanical Actuators: Install mechanical actuators with chain operators where indicated. Extend chains to approximately five feet (1500 mm) above floor and secure to clips to clear aisle passage.

D. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with connections to match pipe fittings.

E. Renewable Seats: Install valves with renewable seats, where applicable.

F. Fluid Control: Except as otherwise indicated, install gate, ball, globe, and butterfly valves to comply with ANSI B31.9. Where throttling is indicated or recognized as principle reason for valve, install ball, globe or butterfly valves, as indicated.

G. Installation of Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.

3.2 ADJUSTING AND CLEANING

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Valve Identification: Tag each valve in accordance with Division-23 section "Identification for HVAC Piping and Equipment".

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of hangers and supports required by this section is indicated on drawings and/or specified in other Division-23 sections.

B. Types of hangers and supports specified in this section include the following:

1. Horizontal-Piping Hangers and Supports
2. Vertical-Piping Clamps
3. Hanger-Rod Attachments
4. Building Attachments
5. Saddles and Shields
6. Spring Hangers and Supports
7. Miscellaneous Materials
8. Roof Equipment Supports
9. Anchors
10. Equipment Supports

C. Hangers and supports furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division-23 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hangers and supports, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable codes pertaining to product materials and installation of hangers and supports.

2. NFPA, UL, and FM Compliance: Provide products which comply with NFPA 13 listed and labeled by UL and FM where used for fire protection piping systems.

3. MSS Standard Compliance:

   a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

   b. Select and apply pipe hangers and supports, complying with MSS SP-69.

   c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

   d. Terminology used in this section is defined in MSS SP-90.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe hanger and support.

PART 2 - PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, selected by Installer to suit horizontal-piping systems in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance

and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.2 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SP-58, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated hangers and supports for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.3 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.4 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building

attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems. Provide copper-plated hangers and supports for copper-piping systems. To avoid future electrolysis or corrosion, copper plated hangers, supports, clamps, rod attachments, and building attachments shall not be in direct contact with copper piping. A separation material shall be installed between the pipe and the copper plated hanger, support, clamp, etc. The separation material shall prohibit electrical conductance and prevent galvanic action or corrosion between dissimilar metals. Separation material shall be guaranteed for a minimum of thirty (30) years.

2.5 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

2.6 SPRING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

2.7 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2).

D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which hangers and supports are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

A. Install attachments at required locations within concrete or steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi (17240 kPa) is indicated, install reinforcing bars through openings at top of inserts.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire-water piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

E. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

H. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

2. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3. For all insulated piping 2-1/2" (63 mm) and larger, provide insulated saddles as follows:

a. For heating water (up to 250°F), provide the following:

1) Minimum 3.5 pcf, non-compressive, rigid, phenolic foam insulation. Fire and smoke rating shall be 25/50 or below per ASTM 84.

2) For cold applications below 75°F (24°C) a zero permeability abuse resistant vapor barrier shall be provided with matching butt strips. Apply a full coating of butyl joint sealant in addition to the butt strips for a completely sealed system.

3) The phenolic foam system shall have a K factor of 0.16 at a mean temperature for 75°F (24°C) and comply with ASTM Standard C1126.

4) Provide visible inspection sticker at the bottom of each saddle.

5) Pipe insulation saddles shall be Tru-Balance CoolDry Saddles as manufactured by Buckaroos, Inc. or equivalent.

I. Spacing: Hanger spacing for piping shall not exceed 8 feet (2400 mm) on centers for pipe 1-1/4" (32 mm) or smaller, and 10 feet (3 m) for pipe 1-1/2" (40 mm) and larger. Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping. For cast iron soil pipe, one hanger shall be placed at each hub or bell.

3.4 ADJUSTMENT OF HANGERS AND SUPPORTS

A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

3.5 EQUIPMENT SUPPORTS

A. Provide concrete housekeeping bases for all floor mounted equipment furnished as part of the work of Division-23. Size bases to extend minimum of 4" (100 mm) beyond equipment base in any direction; and 4" (100 mm) above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

3.6 PAINTING

A. All hangers, supports, clamps and assemblies shall be primed and painted with rust inhibitors.

END OF SECTION

SECTION 23 0548 - VIBRATION ISOLATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: The extent of vibration isolation work to be provided under this Contract is covered by the requirements of this Section, all other Division-23 sections and the Contract Drawings including structural, architectural, mechanical and electrical which identify equipment and systems requiring vibration isolation treatment.

B. Types: Types of vibration isolation equipment and systems specified in this Section include:

TYPE	DESCRIPTION
1 Isolator	Ribbed Neoprene Pads
2I Isolator	Neoprene-In-Shear Type
2H Hanger	Rubber-In-Shear Type
3I Isolator	Open Spring Type
3H Hanger	Combination Spring and Neoprene Type
4 Isolator	Vertically Restrained Spring Isolators
5 Thrust	Restraints Spring Type Installed in Pairs
A Base	Directly Bolted Attachment
B Base	Structural Rails or Bases
C Base	Concrete Inertia Type

C. Selection of Isolators: Provide isolators selected by a vibration isolator equipment specialist.

1. Conform to isolator types herein specified.

2. Examine the contract drawings for sizes, horsepowers, rotational speeds, equipment location, length of span between columns and

beams and construction type to determine the isolator selection type and deflection required for each piece of mechanical equipment.

3. Conform to the requirements of the most current edition of American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook, "HVAC Applications", Sound and Vibration Control.

1.2 QUALITY ASSURANCE

A. Codes: At a minimum, conform to the most current edition of ASHRAE Handbook, "HVAC Applications".

B. Manufacturer: Isolators of the same type shall be the product of the same manufacturer. The manufacturer shall publish and maintain a full line of materials, engineering and application data and operating and maintenance instructions.

1.3 SUBMITTALS

A. Contractor's Certification: Vibration isolator submittals shall include a certification, signed by an officer representing the Contractor and stipulating that the submittal prepared by the manufacturer has been reviewed, and checked on an item by item basis against each piece of mechanical equipment, shown or specified in the Contract Documents, which requires vibration isolation.

B. Manufacturer's Certification: The manufacturer or manufacturers (if there are more than one) shall each certify that the selections of vibration isolation equipment are based upon the drawings and specifications, and that each piece of mechanical equipment has been examined for rotational speed, equipment type, mounting location, and supporting span between column centers, and that an appropriate isolator has been selected.

C. Product Data: Furnish manufacturer's product data covering each isolator type for style, characteristic, and finish.

1. Isolator quantities, dimensions, deflections, capacities and types shall remain the responsibility of the manufacturer and the Contractor.

D. Shop Drawings: Where coordinated shop drawings are required, provide layout drawings, drawn to a scale of not less than 1/4-inch to 1-foot (6

mm to 300 mm), showing the proposed layout of equipment and piping systems and the location and type of each vibration isolation device.

1. Carefully examine other sections requiring coordinated shop drawings and prepare isolation shop drawings to the same scale showing the location of each vibration isolation equipment base, pipe hanger, flexible connection, and isolator.

1.4 STORAGE AND PROTECTION

A. Storage: Store vibration isolation equipment indoors in the manufacturer's original shipping containers. Preclude the entrance of construction dirt and debris.

1. Vibration isolation equipment and bases, which show signs of rust, cement or concrete fouling, dirt and construction debris shall be disassembled and cleaned, approved or removed from the project site and replaced with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Mason

2. Vibration Eliminator Co.

3. Kinetics Noise Control

2.2 EQUIPMENT

A. Dimensions: The schedule shows dimensions for deflection and sizes all in inches.

B. Spans: Where referenced, the schedule shows spans of the longest bay dimension for slabs or beams supported between columns. Dimensions are in feet.

C. Selection: Exact mounting sizes, dimensions and quantity of isolators and static deflection required shall be determined by the isolator

manufacturer based upon equipment that will be furnished and installed by the Contractor under this Contract.

1. Vibration isolation specialist shall coordinate his work with that of other trades to verify that equipment speeds, in revolutions per minute (rpm), are based upon actual equipment installed at the project site.

2. Verify that equipment rpm and spring deflection selected are arranged so that resonance is avoided.

2.3 ISOLATOR TYPES

A. Type 1 Isolators: Provide pad type vibration isolators consisting of either two layers of 3/8-inch (10 mm) thick elastomer, molded to contain a pattern with non-slip characteristics in all directions, and bonded to 16 gauge (1.6 mm) galvanized steel separator plates, or 1-inch (25 mm) thick precompressed molded fiberglass isolation pads. Minimum overall thickness shall be 1-inch (25 mm). Deflection shall be limited to 0.25 inches (6 mm) or less. Loading shall not exceed 40 pounds per square inch (280 kPa).

B. Type 2I Isolators: Provide double rubber-in-shear or elastomer-in-shear with molded-in steel reinforcement in the top and bottom portions.

1. Deflections shall be limited to 0.5 inches (13 mm) or less.

2. Steel bases shall be drilled with mounting holes and equipment mounting points shall be threaded male or female connections.

3. Treat resilient material with antiozone and antioxidant additives.

C. Type 2H Hangers: Provide rubber-in-compression suspension hangers, consisting of a formed steel frame and elastomer isolation element and provided with attachments for top and bottom suspension rods.

1. Design for a minimum 200 percent overload without noticeable deformation or failure.

2. Metal components shall be galvanized or factory painted.

D. Type 3I Isolators: Provide adjustable, freestanding, open spring isolators with combination leveling and equipment fastening bases.

1. Spring elements shall be contained in upper and lower housing assemblies and shall have a minimum Kx-Ky of 0.75.

2. Design springs for a minimum travel of 50 percent beyond the rated load.

3. When fully compressed and "bottomed-out", isolators shall be capable of supporting a 150 percent overload without deformation and spring failure.

4. A minimum 1/4-inch (6 mm) thick non-skid isolation pad shall be bonded to the underside of the base plate.

5. Size base plates to limit floor loading to 100 pounds per square inch (690 kPa).

6. Drill base plates for bolting, as required.

7. Provide means for anchoring the top element of the isolator to rails and equipment.

E. Type 3H Hangers: Provide combination spring and elastomer hangers consisting of a formed steel frame with coil spring and elastomer insert in compression.

1. Design hangers to be capable of supporting a 200 percent overload without noticeable deformation or failure.

2. Design hangers to allow a 30 degree misalignment without binding or a reduction in hanger efficiency.

3. Design hangers for connection to equipment and supporting rods.

F. Type 4 Isolators: Provide vertically restrained, freestanding, laterally stable, open spring type isolators.

1. Design for deflection exceeding 1/2-inch (13 mm).

2. Provide built-in bearing and leveling provisions.

3. Provide a minimum 1/4-inch (6 mm) thick non-slip elastomer vibration absorbing pad bonded to the underside of the isolator base.

4. Outside diameter of each spring shall be equal to or greater than 0.9 times the operating height of the spring under rated load.

5. Provide vertical limit stops to prevent hyperextension due to wind loads or upward movement when the load is removed. Limit stops shall not bind or inhibit spring movement during normal operating ranges.

6. For exterior applications, steel housings shall be hot dipped galvanized and springs shall be neoprene or powder coated.

G. Type 5 Thrust Restraints: Provide spring isolators of an adjustable, freestanding type enclosed within tubular mountings and arranged to be installed in pairs across the discharge of fan flexible connectors.

1. Design restraints to resist the thrust caused by duct internal air pressure.

2. Install restraints on duct systems with an internal static pressure exceeding 3 inches water gauge (750 Pa).

3. Restraints shall have the same deflection as isolators installed under the fans.

2.4 BASE TYPES

A. Type A Bases: No supplementary base is required. Vibration isolators, specified elsewhere, shall be attached directly to the supported equipment or structural system.

B. Type B, Structural Rails or Bases: Provide bases designed and supplied by the isolation equipment manufacturer.

1. Construct bases of mill rolled structural sections of sufficient dimension to limit the midpoint deflection or unsupported spans to 1/1440th of the span between isolators.

2. Include equipment static loadings, power transmission, component misalignment and cantilever loadings when designing structural sections.

3. When head room is limited, coordinate the design of structural rails and isolators to reduce mounting heights.

4. Factory finish with two (2) coats of equipment enamel.

C. Type C, Concrete Inertia Bases: Provide concrete inertia bases designed by the isolator manufacturer and arranged to be filled with concrete in the field.

1. Construct base of mill rolled structural steel sections, factory mitered and welded into a rigid frame and supporting No. 4 reinforcing bars welded to the structural frame 8 inches (200 mm) on centers both ways and located 2 inches (50 mm) from the bottom of the block.

2. Arrange for outrigger isolation mountings, anchor bolts and equipment support.

3. Field fill with 3,000 psi cured-strength concrete. Trowel to a smooth hard finish.

4. Clean structural steel of excess concrete and field paint all steel elements with two coats equipment enamel.

5. Configuration of inertia bases shall be rectangular to accommodate equipment supported unless otherwise indicated.

6. Minimum thickness of inertia bases, in addition to providing suitable mass, shall be sufficient to provide stiffness to maintain equipment manufacturer's recommended alignment and duty efficiency of power transmission.

7. Minimum thickness shall be sufficient to result in a base deflection at midpoint of unsupported span of not more than 1/1440th of the span between isolators.

8. Minimum thickness shall be 8 percent of the longest base dimension unless otherwise specified or indicated.

9. For centrifugal pumps, the bases shall be a minimum 6 inches (150 mm) thick.

10. Where inertia bases are used to mount pumps, the bases shall be long enough to support piping elbows for all connections.

2.5 PIPING AND DUCTWORK

A. General: All ductwork and piping in mechanical equipment rooms and within fifty feet (15 m) of the vibration source (i.e. mechanical equipment such as air handling units, chillers, pumps, cooling towers, air compressors, etc.) shall be isolated from the building structure with flexible vibration isolators. Air handling units with less than two inches (500 Pa) of external static pressure shall be excluded from this requirement.

1. Suspend ductwork on Type 3H hangers.

2. Suspend piping on Type 3H hangers.

3. Floor-mounted ductwork and piping shall be supported with Type 4 spring isolators with deflections the same as the equipment to which the piping is attached.

B. Reciprocating Equipment: Provide spring type hangers with deflections equal to that of reciprocating equipment, with piping arranged with offset elbows to absorb vibration.

C. Risers: Pipe and duct risers within 100 feet (30 m) of mechanical equipment rooms shall be resiliently anchored to the building structure with Type 1 vibration isolators, near the midpoint of the risers.

1. Risers shall be isolated and supported at each second floor with pairs of Type 3H hangers, having deflections a minimum of five times the anticipated thermal movement at the support point.

2. Risers shall be guided as required with four (4) sets of Type 2I vibration isolators.

3. Provide flexible neoprene or canvas connectors as specified in sheet metal ductwork at the connection point to all air moving equipment.

4. Support ductwork with an internal pressure exceeding 3 inches (750 Pa) water with Type 3H hangers on maximum 10 foot (3 m) centers with deflections equal to the equipment isolators.

2.6 VIBRATION ISOLATION SYSTEM SELECTION

A. General: The following selections of vibration isolation equipment systems shall be considered as a minimum. For the equipment below, the following code applies:

Letter (i.e. A, B, C) = Base type

Number (i.e. 1, 2, 3, 4) = Isolator type

Decimal number (i.e. 0.25, 1.5, etc.) = Minimum deflection

B. Refrigeration Reciprocating Compressors:

BASEMENT BELOW GRADE	20 FOOT (6 M) FLOOR SPAN	30 FOOT (9 M) FLOOR SPAN	40 FOOT (12 M) FLOOR SPAN
C 3 0.75	C 3 0.75	C 3 1.5	C 3 2.0

C. Centrifugal Pumps:

TYPE EQUIPMENT	BASEMENT BELOW GRADE	20 FOOT (6M) FLOOR SPAN	30 FOOT (9 M) FLOOR SPAN	40 FOOT (12 M) FLOOR SPAN
Close-coupled thru 7-1/2 hp (5.6 kW)	B or C 2 0.25	C 3 0.75	C 3 0.75	C 3 0.75

D. Low-Pressure AHU Locations (To 3-Inch W.G.) (750 Pa):

TYPE EQUIPMENT	BASEMENT BELOW GRADE	20 FOOT (6M) FLOOR SPAN	30 FOOT (9 M) FLOOR SPAN	40 FOOT (12 M) FLOOR SPAN
Thru 10 hp (7.5 kW)	A 2 0.25	A 3 0.75	A 3 1.0	A 3 1.0
15 hp & over (11 kW & over) 250 to 500 rpm (26 to 52 Rad/s)	A 2 0.35	A 2 1.5	A 3 1.75	A 3 1.75
500 rpm (52 Rad/s)	A 2 0.35	A 3 1.0	A 3 1.5	A 3 1.75

Note: Where floor mounted air handling units are provided with internal vibration isolation for all vibration producing components, provide ¾" neoprene pads.

E. Air Moving Device Locations:

Vibration isolation provisions apply to housed or unhoused freestanding fans of any pressure rating, located in field-erected central-station units or in unhoused return air or supply air service.

TYPE EQUIPMENT	BASEMENT BELOW GRADE	20 FOOT (6M) FLOOR SPAN	30 FOOT (9 M) FLOOR SPAN	40 FOOT (12 M) FLOOR SPAN
Up to 5 hp (Up to 3.7 kW)	A or B 2 0.25	B 3 1.0	B 3 1.0	B 3 1.5
5 thru 40 hp (3.7 thru 29.8 kW) 200 to 500 rpm (21 to 52 Rad/s)	B 3 1.5	B 3 1.5	B 3 1.5	B 3 2.5
500 rpm (52 Rad/s) & over)	B or C 3 0.75	C 3 0.75	C 3 1.5	C 3 2.5

PART 3 - EXECUTION

3.1 INSTALLATION

A. Manufacturer: All vibration isolation equipment shall be installed in accordance with the manufacturer's recommendations.

B. Manufacturer's Representative: The vibration isolation installation and deflection testing after equipment start-up shall be conducted by a representative of the manufacturer.

3.2 TESTS AND REPORTS

A. Testing: Each vibration isolation device shall be deflection tested. Two (2) copies of a bound report shall be submitted prior to final acceptance. The certification shall include the following:

1. Certify that equipment has been isolated in accordance with Contract Drawings, specifications and submittals.

2. Certify that all minimum specified deflections have been equaled or exceeded.

3.3 ANCHORING

A. Installation: Installation shall comply with manufacturer's published recommendations and shall be installed so that isolators are plumb and are operating at a manner for which they were designed.

1. Unless otherwise specified, all equipment shall be securely bolted to isolators, steel bases or concrete inertia bases.

2. Indoor vibration isolators need not be attached to the structure unless required by local codes.

3. Isolators installed outdoors shall be attached to building structure.

3.4 CLEANING

A. Debris: Remove all debris from under equipment, and thoroughly clean steel bases, inertia bases and check for free movement.

B. Adjustment: Adjust isolators as required for proper operation prior to starting equipment. Testing of vibration isolators shall be performed by a

certified representative of the manufacturer as specified.

3.5 GENERAL

A. All exterior structural steel and/or steel housings of exterior vibration isolation materials shall be hot dipped galvanized.

END OF SECTION

SECTION 23 0549 - SEISMIC AND WIND CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section specifies the minimum requirements for restraining HVAC systems and equipment.

B. The requirements of this section must be coordinated with the requirements of Division-23 section, Vibration Isolation for HVAC Piping and Equipment.

C. This Section includes the following:

1. Isolation pads
2. Channel support systems
3. Hanger rod stiffeners
4. Anchorage bushings and washers
5. Restrained elastomeric isolation mounts
6. Restrained spring isolators
7. Restrained vibration isolation roof curb/rail assemblies
8. Restraint snubbers
9. Restraining braces and cables
10. Flexible connectors for restraint applications

1.3 APPLICABLE STANDARDS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

D. ASCE-7: Minimum Design Loads for Buildings and Other Structures.

E. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. All components mounted outside of the building structure shall be mounted to resist minimum wind loads per IBC requirements.

1. Basic Wind Speed: See Structural Drawing General Notes.

2. Building Classification Category: See Structural Drawing General Notes.

3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. All HVAC components shall be mounted to resist seismic loads per IBC requirements.

C. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: See Structural Drawing General Notes.

2. Assigned Seismic Building Occupancy Category as Defined in the IBC: See Structural Drawing General Notes.

a. Component Importance Factor: See Schedule in Part 3 of this Section.

b. Component Response Modification Factor: Per ASCE-7 Table 13.6-1.

c. Component Amplification Factor: Per ASCE-7 Table 13.6-1.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Structural Drawing General Notes.

4. Design Spectral Response Acceleration at 1.0-Second Period: See Structural Drawing General Notes.

1.5 SUBMITTALS

A. All product submittals shall be in accordance with ASCE-7.

B. Product Data: For the following:

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of restraint component used.

C. Delegated-Design Submittal: For support systems required to comply with performance requirements and design criteria, include project specific load analysis data signed and sealed by the qualified professional engineer responsible for their preparations. Design shall be per ASCE-7 requirements.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation and seismic and wind forces required to select restraints.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.

3. Seismic and Wind Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and/or wind restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic and/or wind load events. Indicate association with vibration isolation devices.

c. Coordinate seismic and/or wind restraint details required for equipment mounted outdoors. Comply with requirements in other Division-23 Sections for equipment and components mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to the AHJ showing maximum ratings for restraint components (tests or calculations).

D. Coordination Drawings: Show coordination of seismic and/or wind load bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic and/or wind restraints.

E. Welding certificates.

F. Qualification Data: For professional engineer and testing agency.

G. Field quality-control inspection reports.

H. Provide certification for testing or experience data for specific Division 23 equipment (refer to individual specification sections) per ASCE-7.

1.6 QUALITY ASSURANCE

A. Comply with seismic and wind restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Restraint devices shall have horizontal and vertical load analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum restraint ratings. Submittals based on independent testing and/or calculations are acceptable. Calculations (including combining shear and tensile loads) to support restraint designs must be signed and sealed by a qualified professional engineer.

D. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements of this section, provide products

by Kinetics Noise Control or equivalent.

B. Provide appropriate product(s) from those listed below to meet the requirements of restraining or restraining/vibration isolating HVAC components.

2.2 COMBINATION RESTRAINT/VIBRATION ISOLATION DEVICES FOR INDOOR OR OUTDOOR PAD MOUNTED EQUIPMENT

A. Restrained Rubber/Neoprene Mounts, Model RQ: All-directional restrained mountings.

1. Materials: Cast-ductile-iron or welded steel housing containing oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

B. Restrained Spring Isolators, Model FHS: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

5. Housing: Factory drilled for bolting to structure

C. Restrained Spring Isolators, Models FLS / FLSS: Freestanding, steel, open-spring isolators with limit-stop/restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

D. Modular Restrained Spring Isolator, Model FMS:

1. Housing: Ductile-iron or steel housing to provide all-directional restraint.

2. Base: Factory drilled for bolting to structure.

3. Equipment Mount: Factory drilled for bolting to the equipment.

4. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

5. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

2.3 FLEXIBLE CONNECTORS TO ACCOMMODATE DIFFERENTIAL MOTION

A. Basis-of-Design Product: Subject to compliance with requirements of this section, provide flexible connectors to accommodate differential motion by Engineered Flexible Products (EFP) or equivalent.

B. General Requirements for Flexible Connectors to Accommodate Differential Motion:

1. Flexible connectors shall be chosen to accommodate differential motion caused where piping and duct crosses seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

2. Flexible connectors shall not introduce any thrust loads into the distribution system and shall contain a welded on braid.

3. Flexible connectors shall be constructed of stainless steel braid with carbon steel end fittings and/or bronze braid with copper end fittings.

4. Flexible connectors shall be V-shaped and capable of accommodating up to 4 inches (100 mm) of differential motion from centerline.

5. Flexible connectors shall be supplied by restraint supplier as part of restraint system.

2.4 SEISMIC AND WIND RESTRAINT DEVICES

A. General Requirements for Concrete Anchoring Components:

1. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

2. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be per IBC.

3. Provide product model indicated by Kinetics Noise Control or approved equal.

B. Equipment mounting clips, Model KSMG: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismically rated, with an ICC-ES report.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

C. Snubbers, Model HS-5 or approved equivalent:

1. Designed to be used in pairs and limit lateral and vertical equipment motion when placed at the base of vibration-isolated equipment and when securely anchored to the building structure.

2. To be installed such that the neoprene bushing attached to the base anchor will come into contact with the interior surface of the floor mounted angle restraint bracket once the equipment has been displaced approximately 1/8" (3 mm) in any direction.

3. A registered professional engineer shall design the snubber steel members, or certified test reports shall be submitted which verify the capacity of each snubber.

4. Snubbers shall be fabricated from structural steel and shall be attached to the building structure in a manner consistent with anticipated loads. Snubbers shall meet all requirements of the IBC and ASCE 7.

5. Snubbers shall be placed around equipment as needed to limit lateral or vertical motion at each snubber location to 1/8" (3 mm). A minimum of two (2) snubbers shall be installed around each resiliently supported piece of equipment.

6. Snubbers shall include resilient neoprene pads with bronze backing to cushion any impact and shall be installed and inspected so as to be free of contact during normal non-seismic equipment operation.

D. Cable Restraint Kit, Model KSCU, KSWC, or KSCC: A pair of pre-stretched steel cables with end connections made of steel assemblies with thimbles (if vibration isolation is needed), brackets, swivels, and bolts designed for restraining cable service.

1. Kit shall include all hardware required for connection to the equipment/system.

2. Kit shall include a tool-less connector to avoid cable cutting and saddle clamps where possible.

3. Cables shall have one end pre-swaged from the manufacturer.

4. Cable size shall be 2 mm, 3 mm, 5 mm, and/or 6 mm in diameter depending on calculated design load.

5. Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.

E. Hanger Rod Stiffener, Model KHRC: Clamp for attaching reinforcing steel angle to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Wedge Type Anchor Bolts, Model KCAB/KCCAB/KUAB: Select anchor bolts with strength required for anchorage and as tested according to ASTM E 488. Minimum length of anchor to be eight times diameter. Anchor bolts shall be designed in accordance with ACI 318 or TMS 402 as applicable.

1. Anchor bolts to be zinc-coated steel for interior applications and stainless steel for exterior applications.

2. For equipment that is rigidly mounted and has 10 horsepower or less use drilled-in and stud-wedge or female-wedge type anchor.

3. For equipment that is rigidly mounted and has greater than 10 horsepower, use undercut anchors.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Installation shall be in accordance with requirements of ASCE-7.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation member of ICC.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on delegated design drawings to receive them and where required to prevent buckling of hanger rods due to seismic and/or wind load forces.

C. Strength of Support and Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic and/or wind loads within specified loading limits.

3.3 SEISMIC AND WIND RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in architectural specifications for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment and Hanger Restraints:

1. Install restrained isolators on mechanical equipment.

2. Install restraint snubbers on equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

3. Combination restraint/vibration isolation devices may be installed in lieu of separate vibration isolators and restraint snubbers if they conform to all requirements of this specification and Division-23 Section, Vibration Isolation for HVAC Piping and Equipment.

4. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

5. Install restraint devices using methods provided by restraint supplier and required submittals for component.

C. Piping Restraints:

1. Comply with requirements of restraint system manufacturer.

2. Restrain per current editions of IBC & ASCE.

D. Ductwork Restraints:

1. Comply with requirements of restraint system manufacturer.

2. Restrain per current editions of IBC & ASCE.

3. Restrain all ductwork except as listed below:

a. Ducts with a cross-sectional area of less than 6 sqft., weigh less than 20 lb/ft and provisions have been made to avoid impact with other ducts or mechanical components as indicated in ASCE-7.

E. Piping Riser Restraints:

1. Restrain per sections 3.3.A and 3.3.B.

2. Comply with requirements of restrain system manufacturer.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install restraint devices using methods approved by the restraint supplier required by the submittals for the component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges/webs of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and other utilities.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping and duct where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

B. Flexible connections to be supplied by restraint supplier.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four or 10% (whichever is greater) of each type and size of installed anchors and fasteners.

5. Test to 90 percent of rated proof load of device.

6. Measure isolator restraint clearance.

7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

B. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-23 sections.

B. Types of identification devices specified in this section include the following:

1. Pipe and Duct Markers
2. Painted Identification Materials
3.
4. Valve Tags
5. Valve Schedule Frames
6. Engraved Plastic-Laminate Signs
7. Plastic Equipment Markers
8. Plasticized Tags

C. Refer to requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 or Owner standards for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" (213 mm x 275 mm) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.

C. Maintenance Data: Include product data and schedules in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers' products which may be incorporated in the work include the following:

1. Brady

2. Seton

3. Bunting

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option but provide single selection for each product category.

2.3 PIPE AND DUCT MARKERS

A. Snap-on Type: Provide pre-printed, semi-rigid, snap-on color coded identification sleeves complying with ANSI A13.1. This type shall be used for insulated pipe sizes 2" and smaller.

B. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive, vinyl markers conforming to ANSI A13.1. This style marker shall be applied to all uninsulated piping; insulated piping 2-1/2" and larger, and all ductwork.

C. Flow Direction: Provide flow directional arrows either as part of markers, or separately attached to pipes and ducts.

2.4 PAINTED IDENTIFICATION MATERIALS

A. Piping and Equipment Systems: Continuous color coded painting of piping and equipment shall be provided in all mechanical rooms in compliance with ANSI A13.1.

2.5 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage (1.2 mm) polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" (6 mm) high letters and sequenced valve numbers 1/2" (13 mm) high, and with 5/32" (4 mm) hole for fastener.

1. Provide 1-1/2" (40 mm) diameter tags, except as otherwise indicated.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.6 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with lexan.

1. Locate one schedule where directed. Provide second schedule to Owner framed in rigid plastic frame with rigid plastic glazing.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for

mechanical fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: 1/16" (1.6 mm) for units up to 20 sq. in. (12900 mm^2) or 8" (200 mm) length; 1/8" for larger units.

B. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

C. Duty: Accident-prevention tags with appropriate wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.8 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and schedule number

2. Equipment service

2.9 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown on plans. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with pressure sensitive markers and arrows, showing ductwork service and direction of flow.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft or similar concealment), and at 25 foot (7500 mm) spacings.

C. Access Doors: Provide duct markers on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.

B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) exterior non-concealed, locations, and concealed gas piping.

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

4. At access doors and similar access points which permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced intermediately at maximum spacing of 25 feet (7500 mm) along each piping run.

C. Gas Pipe: Paint exposed gas pipe throughout (except chromium plated).

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Comply with requirements of "Valve Schedule" of this section.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

2. Fuel-burning units including boilers, furnaces and heaters.

3. Pumps, condensers and similar motor driven units.

4. Heat recovery units and similar equipment.

5. Fans and blowers.

6. Air handling units.

7. Tanks and pressure vessels.

8. Water treatment systems and similar equipment.

B. Lettering Size: Minimum 1/4" (6 mm) lettering for name of unit where viewing distance is less than 2'- 0" (600 mm - 0 mm), 1/2" (13 mm) high for distances up to 6'- 0" (1800 mm - 0 mm), and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

C. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

3.8 IDENTIFICATION SCHEDULE

SERVICE	DESIGNATION
Refrigeration Suction	SUCTION
Refrigeration Liquid	LIQ
Low Pressure Condensate Return	LPR #
Heating Water Supply	HS
Heating Water Return	HR

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of testing, adjusting, and balancing (TAB) work required by this section is indicated on drawings and schedules, and by requirements of this section, and is defined to include, but is not necessarily limited to, air distribution systems, hydronic distribution systems, and associated equipment and apparatus of mechanical work. The work consists of setting speed and volume (flow), adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports to achieve the capacities or setpoints indicated on the contract documents, and recommending modifications to work as required to achieve the capacities or setpoints indicated on the contract documents.

B. Component types of testing, adjusting, and balancing specified in this section shall include, but not be limited to, the following as applied to mechanical equipment:

1. Building automated systems
2. Fans
3. Air handling units
4. Ductwork systems
5. Pumps
6. Coils
7. Boilers
8. Piping systems
9. Terminal units
10. Air devices

C. Refer to requirements of Division-26.

D. See drawings for pre-demolition testing requirements (where applicable).

1.2 QUALITY ASSURANCE

A. Tester's Qualifications: A firm certified by Associated Air Balance Council (AABC) who is not Installer of system to be tested.

1. AABC Compliance: Comply with the current AABC's Manual "AABC National Standards", as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.

2. Industry Standards: Comply with AABC recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing, except as otherwise indicated.

3. ASHRAE Standard 111: Comply with current edition of ASHRAE 111, "Measurement, Testing, Adjusting and Balancing of HVAC Systems".

4. Independence: TAB contractor shall be independently owned and operated with no affiliation with the general contractor, mechanical contractor, sheet metal contractor, design engineer, etc.

5. Experience: Each technician shall demonstrate a minimum of three years of actual test and balance field experience.

B. Pipe Testing Procedures: Contractor shall pressure test all piping systems in accordance with the following:

1. ASME Code for Pressure Piping B31, most current edition.

2. National Fire Protection Association (NFPA), all applicable sections, most current edition.

1.3 SUBMITTALS

A. Qualification: TAB contractor qualifications shall be provided as a formal submittal for review to demonstrate conformance with all qualifications indicated throughout the contract documents.

B. Submit certified test reports, signed by the AABC Test and Balance technician who performed the TAB work. In addition, the report shall be certified by an AABC certified Test and Balance Engineer (T.B.E.) who is familiar with the project.

1. Include identification and types of instruments used, and their most recent calibration date with submission of final test report.

C. The Contractor shall maintain a copy of AABC standards on the site during all TAB work. Said document(s) shall be made available to Owner representatives for reference as to minimum requirements.

D. Maintenance Data: Include in maintenance manuals, copies of certified test reports, identification of instruments.

1.4 JOB CONDITIONS

A. Do not proceed with testing, adjusting, and balancing work until work has been completed, tested, operable, and all balancing devices indicated on the contract documents have been installed. Ensure that there is no residual work still to be completed on the equipment to be tested.

B. Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

1. Factory fabricated plastic plugs shall be used to patch drilled holes in ductwork and housings.

2.2 TEST INSTRUMENTS

A. Utilize test instruments and equipment for TAB work required, of type, precision, and capacity as recommended in the following TAB standards:

1. AABC's Manual "AABC National Standards".

2. Wherever permanently installed measuring equipment is provided, such as air volume monitors, flow meters, temperature and pressure gages, etc., these shall be used in addition to TAB instrumentation. Any discrepancies in accuracy shall be brought to the attention of the Owner. Where permanently installed instrumentation meets accuracy requirements for TAB work, they may be used provided TAB Contractor can verify calibration of installed instruments.

B. The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser air flow measurements.

PART 3 - EXECUTION

3.1 FIELD WORK

A. Prior to the mechanical installation, the mechanical and TAB contractors shall review the design documents for "balanceability" to confirm that all devices required to properly balance each system are to be provided under this contract. Recommended modifications and/or additions shall be made directly to the engineer and a minimum of 30 days prior to the installation of mechanical equipment.

B. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned, operable and accessible. Do not proceed with TAB work until unsatisfactory conditions have been corrected.

C. Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable AABC standards. All systems and components shall be balanced within ±5% of design air and water flows.

D. Test, adjust and balance system during summer season for cooling and during winter season for heating systems, including operation at outside conditions within 3°F (2°C) wet bulb temperature of maximum summer design condition, and within 10°F (6°C) dry bulb temperature of minimum winter design condition. When seasonal operation does not permit measuring final temperatures, then take final temperature readings when seasonal operation does permit.

E. For fan systems, provide sheave replacements where required to achieve specified air flows.

F. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer.

3.2 REPORTS

A. Prepare report of test results, including instrumentation calibration reports, in format recommended by AABC standards. Provide a System Summary page(s) at the front of the report.

B. An interim/preliminary handwritten report shall be submitted to the Engineer for review prior to the formal submission of the report.

C. Test reports shall include, but not be limited to, the following information:

1. Air Handling Equipment Test:

a. Air handling equipment shall include, but not be limited to, all fans (supply, exhaust, return, relief, make-up, ventilation, etc.), air handling units, VRF terminals. etc.).

b. Design Conditions: CFM, static pressure, motor h.p., outside air CFM (where applicable), fan and motor RPM and fan motor h.p. for each fan.

c. Installed Equipment: Manufacturer, size, arrangement, class, motor h.p., volts, phase, cycles, and full load amps.

d. Field Test Results: Fan CFM, fan RPM, fan motor voltage, fan motor operating amps, fan motor operating b.h.p., total static pressure for each fan. In addition, where applicable provide external static pressure, air pressure drop across each coil, filter bank, attenuator, etc. (ie. provide total static pressure profile of each system), as well as leaving air temperature, outside air conditions (dry bulb/wet bulb) at time of test, coil flow data (GPM), coil entering and leaving air temperatures, coil entering and leaving water temperatures, coil water pressure drop, VFD settings at final test conditions, and duct static pressure setpoint. Air temperature difference measurements will not be acceptable.

2. Air Distribution Test: Main and major branch ducts and individual supply, return and exhaust terminals (diffusers, registers and grilles):

a. Design Conditions: Ductwork: CFM, duct size. Air terminals, diffusers, registers, grilles: CFM, module size and inlet size.

b. Field Test Results: Ductwork: CFM, duct size, number of velocity readings, average velocity reading. Air terminals, diffusers, registers, grilles: CFM, module size and inlet size.

3. Pump Test:

a. Design Conditions: GPM, Head, RPM, motor h.p.

b. Installed Equipment: Manufacturer, size, type drive, motor h.p., volts, phase and cycles, full load amps.

c. Field Test Results: Shut-off head, discharge pressure, suction pressure, GPM, operating head, pump motor operating amps, pump motor operating b.h.p., VFD settings at final test conditions and differential pressure setpoint.

4. Miscellaneous Test Results:

a. All Coils: Air pressure drop, water pressure drop, water flow (GPM), air flow (CFM), entering water temperature, leaving water temperature, entering air temperature, leaving air temperature and outside air temperature at time of test (where applicable) and BTU calculations. Air temperature difference methods will not be acceptable.

b. Air Flow Monitors (AFM): Provide verification of AFM accuracy including set-up and adjustment required to verify proper operation and accuracy of each AFM system.

c. Sound Readings: Provide ten (10) sound power level readings at locations to be selected by the Engineer.

d. Balance Valves: All balance valves (including hydronic and domestic water) shall be adjusted and balanced to include water flow (GPM) and pressure drop (where applicable). Indicate manufacturer/model of each valve type.

D. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced; including, where necessary, modifications which exceed requirements of contract documents for mechanical work.

E. Record outdoor air temperature (dry bulb and wet bulb) at the time of testing air handling units, boilers and any other equipment where performance is affected by outdoor air conditions.

F. Report shall include results of piping and ductwork tests indicated in paragraphs 3.03 and 3.04 of this section.

3.3 TESTS - PIPING

A. Prior to the balancing of systems by the AABC certified balancing contractor, the mechanical contractor shall air and/or hydrostatically test the following systems in accordance with the latest ASME B31 (ASME Code for Pressure Piping) and NFPA requirements.

1. Air Test:

a. Refrigeration Liquid and Suction Line

2. Hydrostatic Test:

a. Heating Water Supply and Return Piping

B. Pressure tests shall also be performed prior to the installation of all insulation materials.

C. Hydrostatic Test: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed, wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

1. Required test period is four (4) hours.

2. Hydrostatically test each piping system at 150% of operating pressure indicated, but not less than 100 psi (690 kPa) test pressure.

3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds one percent (1.0%) of test pressure.

4. Upon completion of roughing-in and before setting fixtures, the entire new domestic water system shall be tested. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system.

5. Prior to testing, verify the pressures listed above are in accordance with the latest ASME B31 code and NFPA. Should a discrepancy exist between the ASME B31 code, NFPA, and/or the pressures indicated above, contact the Engineer prior to testing.

D. Air Test:

1. Refrigerant piping shall be air tested at 550 psi (3800 kPa) as follows:

a. Pressure Test (Air Tight Test): Pressurize the suction gas pipe, high/low pressure gas pipe and liquid pipe with dry nitrogen to a minimum pressure as per the system manufacturer. Pressure test duration shall be a minimum of 24 hours. If the pressure does not drop within the 24 hour period, the system passes. If there is

a drop in pressure, check for leaks, make repairs and re-test as prescribed above.

b. Evacuation Test (Vacuum Drying): Evacuate the system from the suction gas pipe, high/low pressure gas pipe and liquid pipe to a minimum vacuum pressure as per the system manufacturer. Vacuum pressure shall be maintained in accordance with manufacturer's minimum duration recommended. If it rises, the system may either contain moisture or have leaks, if so, make repairs and re-test as prescribed above.

c. Refer to the Refrigerant Leakage Test Summary Form at the end of this section to document test results. No other form will be acceptable. Submit results for all systems for review.

E. Repair or replace refrigerant piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

F. Refer to Division-23 section "Testing, Adjusting and Balancing" for additional specific test criteria and test form to be completed.

3.4 TESTS - DUCTWORK

A. Prior to the balancing of systems by the AABC certified balancing contractor, all high and low pressure systems shall be tested by the mechanical contractor for duct leakage. Duct leakage shall not exceed 1%. In addition, current SMACNA and AABC Standards shall apply, where applicable, to meet the maximum 1% leakage. Duct leakage shall not exceed 1% of design cfm for a duration of ten (10) minutes. Test pressures shall be not less than the following:

Ductwork systems less than 2.0 in. wg E.S.P.:

(Duct Pressure Class 2): Test to 2 in. wg

B. Insulation materials shall not be applied until systems have been witnessed, documented, and submitted to meet the above testing requirements.

C. The balance contractor shall witness and certify all duct pressure tests.

D. Contractor shall submit duct leakage test results to the A/E within 72 hours of completed tests. Only test results that meet the specified leakage requirements shall be submitted. Duct test results shall be recorded on the attached "Air Duct Leakage Test Summary Form" at the end of this

section; no other forms will be accepted. In addition, the duct leakage submittals shall include 11x17 drawing(s) as required to clearly indicate the full extent of the duct test section (each duct test section shall be numbered and color coded).

E. All duct leakage test results shall be included with the final TAB report and the O&M manual. The orifice tube calibration chart shall also be included with the final duct leakage test report information.

3.5 TESTS - EQUIPMENT

A. The contractor shall verify calibration of all indicating, recording, controlling and controlled devices throughout the mechanical system. Verify the proper function of all installed equipment and devices and the interlocking of all new systems as required by the contract documents.

B. A report including successful calibration and function performance verification of all items indicated above shall be included in the Operations and Maintenance Manual.

3.6 FUNCTIONAL PERFORMANCE TESTING AND VERIFICATION

A. General: In addition to the tests required during and after installation of all mechanical systems, as well as any other formal commissioning requirements, the Contractor shall perform functional performance tests to verify that all systems are designed, installed, calibrated and adjusted to perform as required in the Contract.

B. Comply with all applicable specification sections including, but not be limited to, "Basic HVAC Requirements", "Testing, Adjusting and Balancing", "Automatic Temperature Controls" and "Commissioning", where applicable.

C. Prior to functional performance testing, all indicating, recording and control devices shall be calibrated. A verification calibration report shall be provided with the final test report.

D. Provide functional performance testing to verify proper operation of each and every control sequence indicated throughout the contract documents.

E. Failure of Tests: Should any test, verification, or demonstration fail to meet the specification requirements, the component of the system causing the failure shall be repaired, replaced or readjusted. The failed test, verification, or demonstration shall then be repeated.

F. A "Functional Performance Test Verification Form" is included at the end of Section 230900. This form (electronic version is available upon request) shall be completed for all mechanical equipment provided under this contract. This shall include, but not be limited to each boiler, air handling unit, fan, pump, DX cooling equipment, miscellaneous heating equipment, etc.

G. Test Report: Upon satisfactory verification of calibration and functional performance tests, a copy of the final test results shall be bound in the operations and maintenance manual. The final report shall also include a full compliance statement, on company letterhead, indicating that all systems are installed and functioning per the contract requirements including drawings, specifications, control sequences and accepted submittals.

H. The mechanical systems shall not be considered complete until all functional performance verification forms, calibration reports and compliance statement have been submitted and reviewed. Submit in accordance with the submittal requirements indicated elsewhere in these specifications.

3.7 FINAL TESTS, INSPECTION AND ACCEPTANCE

A. At time of final inspection, Contractor shall recheck, in presence of Owner's Representative, random selections of data (water and air quantities, air motion, and sound levels) recorded in Certified Report. In addition, auditoriums and conference rooms shall be rechecked.

1. Points and areas for recheck shall be selected by Owner's Representative.

2. Measurement and test procedures shall be same as approved for work forming basis of Certified Report.

3. Selection for recheck (specific plus random), in general, will not exceed 25 percent of total number tabulated in report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from, or a sound level of 2 db or more, greater than that recorded in Certified Report listings, at 10 percent or more of the rechecked selections, report shall automatically be rejected. In the event the report is rejected, systems shall be readjusted and tested, new data recorded, new Certified Reports submitted, and new inspection tests made, at no additional cost to the Owner.

C. Marking of Settings: Settings of valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor so that adjustment can be restored if disturbed at any time.

END OF SECTION

AIR DUCT LEAKAGE TEST SUMMARY FORM

Project Name: _____ Project Number: _____ Page __of__

DESIGN DATA						FIELD TEST DATA RECORD								
Duct Test Section (No./Color)	Air System	Total System CFM	Test Section CFM	Allowable Leakage %	Allowable Leakage CFM	Diameter		Pressure (in. w.g.)		Actual Leakage CFM	Actual Leakage %	Test Result Pass/Fail	Test Performed By (initials)	Test Witnessed By (initials)
						Orifice	Tube	Duct(1)	Across Orifice					
				1.0%										
				1.0%										
				1.0%										
				1.0%										
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				1.0%										
				1.0%										
				1.0%										
				1.0%										
				1.0%										
				1.0%										
				1.0%										

Testing Performed By: _____
(Company/Individual Name)

Witnessed/Certified By: _____
(Company/Individual Name)

(1) Duct test pressure shall be 6.0 in. w.g. for High/Medium Pressure ductwork, or 2.0 in. w.g. for Low Pressure ductwork.

PIPING LEAKAGE TEST SUMMARY FORM

(HYDRONIC AND AIR)

Project Name: _____ Project Number: _____ Page _____ of _____

System Tested	Sections Tested (1)	System Operating Pressure	Test Pressure (2)	Duration (3)	Pressure Drop (4)	Pass/Fail

Name of Testing Agency/Company:

Date of Test(s): _____

Test Conducted By (Print/Sign): _____

(1) Identified by an 11 x 17 numbered and color coded test section plan. Plan shall accompany this test report.
(2) 150% of operating pressure but not less than 100 psi (hydronic)and 400 psi (refrigerant).
(3) Four (4) hours minimum.
(4) Shall not exceed 0.0%.

PIPING LEAKAGE TEST SUMMARY FORM

(REFRIGERANT PRESSURE TEST)

Project Name: _____ Project Number: _____ Page _____ of _____

System/Unit Tested (1)	Test Location	Test Pressure (2)	Actual Test Pressure	Test Start			Test Completion			Pressure Drop (4)	Pass/Fail
				Time	Temperature	Pressure	Time	Temperature	Pressure		

Name of Testing Agency/Company: _____

Date of Test(s): _____

Test Conducted By (Print/Sign): _____

(1) Equipment designation.
(2) Per manufacturer's recommendation.
(3) Twenty-four hours minimum from start to completion.
(4) Shall not exceed 0.0%.

PIPING LEAKAGE TEST SUMMARY FORM

(PLUMBING)

Project Name: _____ Project Number: _____ Page _____ of _____

System Tested	Sections Tested (1)	System Operating Pressure	Test Pressure (PSI/FT-HD) (2)	Duration (3)	Pressure Drop (4)	Pass/Fail

Name of Testing Agency/Company: _____

Date of Test(s): _____

Test Conducted By (Print/Sign): _____

(1) Identified by an 11 x 17 numbered and color coded test section plan. Plan shall accompany this test report.

(2) 150% of operating pressure but not less than 100 psi , 10 ft. static head pressure or to the maximum rating of the joint. Include joint cut sheets showing their ratings.

(3) Four (4) hours minimum.

(4) Shall not exceed 0.0%.

SECTION 23 0700 - HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of mechanical insulation required by this section is indicated on drawings and schedules, by requirements of this section, and all other Division-23 sections.

B. Types of mechanical insulation specified in this section include the following:

1. Piping System Insulation:
    a. Fiberglass
    b. Flexible Elastomeric
2. Ductwork System Insulation:
    a. Fiberglass
    b. Flexible Elastomeric
    c. Polyisocyanurate
3. Equipment Insulation:
    a. Fiberglass
    b. Flexible Elastomeric

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firms with at least five (5) years successful installation experience on projects with mechanical insulations similar to that required for this project. Provide installer's certification by the manufacturer's training program where applicable.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories, and intended use for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work, shall be limited to the following:

1. Owens Corning
2. Johns Manville
3. Certainteed
4. Armacell
5. Knauf

6. Aeroflex

2.2 PIPE INSULATION MATERIALS

A. Fiberglass Pipe Insulation: ASTM C 547, Type 1 (up to 850°F) (up to 454°C), maximum k-value of 0.23 BTU-in/hr-ft^2-deg F at a mean temperature of 75°F.

B. Flexible Elastomeric Pipe Insulation: ASTM C 534, Type I (-40°F to 200°F) (-40°C to 93°C), maximum k-value of 0.25 BTU-in/hr-ft^2-deg F at a mean temperature of 75°F.

C. Jackets for Piping Insulation: Jacket assembly shall be ASTM C 1136, Type I with vapor retarder (0.02 perms). All service jackets shall have a polymer coated exterior facing, shall resist water staining and shall not support mold or mildew growth. All service jackets shall be Owens Corning ASJ Max with SSLII closure system, or equivalent.

1. All fittings shall be provided with pre-molded insulation with equivalent thickness and composition of insulation applied to the adjoining piping. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.

2. Encase exterior piping insulation with 26 gauge embossed aluminum jacket with weather-proof construction.

D. Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealer, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.3 DUCTWORK INSULATION MATERIALS (INDOOR)

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612-00, Type 1A (up to 450°F) (up to 232°C), minimum k-value of 0.27 BTU-in/hr-ft^2-deg F at a mean temperature of 75°F (24°C).

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, maximum k-value of 0.27 BTU-in/hr-ft^2-deg F or minimum "out of package" R-value of 6.7 at a mean temperature of 75°F. For ductwork in ceiling space directly below roof, provide insulation with maximum k-value of 0.25 and minimum "out of package" R-value of 8.0 (1.5 LBS/FT^3 density).

C. Flexible Elastomeric Duct Wrap Insulation ASTM C 534, Type II, R-value of 8.0 at 2", (-40°C to 93°C).

D. Ductwork Insulation Accessories: Provide bands, wires, tape, anchors, corner angles, and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

F. Finish: Where indicated on drawings, ductwork insulation must be paintable.

2.4 EQUIPMENT INSULATION MATERIALS

A. Rigid Fiberglass Equipment Insulation: ASTM C 612-00, Type 1A (up to 450°F) (up to 232°C).

B. Flexible Elastomeric Cellular Sheet Insulation: ASTM C 534, Type 2, R-value of 8.0 at 2", (-40°F to 200°F) (-40°C to 93°C).

C. Jacketing Material for Equipment Insulation: Provide 8 ounce (227 g) canvas or pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard (263 g/m^2), or metal jacket at Installer's option, except as otherwise indicated.

D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Accessories: Provide bands, wire, wire netting, tape corner angles, anchors, stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Only install mechanical insulation on systems while not in operation.

3.2 HVAC PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on hot piping within radiation enclosures and air conditioning condensate piping in mechanical rooms and/or on roofs.

B. Refrigerant Piping (0 Degrees F - 200 Degrees F) (-18 Degrees C –93 Degrees C):

1. Application Requirements: Insulate the following HVAC piping systems:

a. All refrigerant piping (gas and liquid).

2. Insulate piping system(s) specified above with the following type and thickness of insulation:

a. Flexible Elastomeric: 1" (25 mm) thick.

C. Hot Piping (to 200 Degrees F) (to 93 Degrees C):

1. Application Requirements: Insulate the following hot HVAC system (water piping up to 200°F) (water piping up to 93°C).

a. HVAC hot water supply and return piping.

2. Insulate each piping system specified above with the following type and thickness of insulation:

a. Fiberglass: 1-1/2" (40 mm) thick for pipe sizes up to and including 1-1/4" (32 mm), 2" (50 mm) thick for pipe sizes 1-1/2" (40 mm) and larger.

D. Insulation of Piping Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by the manufacturer.

3.3 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted: Do not insulate fibrous glass ductwork, or lined ductwork located inside the building.

B. Cold Ductwork:

1. Application Requirements: Insulate the following cold ductwork:

a. Unconditioned outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.

b. HVAC supply air ductwork from air handling unit/fan discharge to diffuser or register, including all duct accessories (sound attenuators, etc.).

c. HVAC conditioned outside air ductwork connected to DOAS (dedicated outside air) system from unit discharge to diffuser or register.

d. HVAC return ductwork located in ceiling directly adjacent to roof, including all duct accessories (sound attenuators, etc.).

e. HVAC exhaust ductwork located in ceiling directly adjacent to roof, connected to DOAS (dedicated outside air) system.

f. HVAC plenums and unit housings not preinsulated at factory or lined.

g. Insulate neck and bells of supply diffusers.

2. Insulate each ductwork system specified above with the following type and thickness of insulation:

a. Flexible Fiberglass: 2" (50 mm) thick with R-value of 6.7 (provide 2" thick with minimum R-value of 8.0 for supply ductwork located in ceiling space directly below roof), application limited to concealed locations.

b. Rigid Fiberglass: 2" (50 mm) thick, application limited to ductwork exposed to view, including mechanical rooms.

C. Hot Ductwork (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot ductwork:

a. Hot supply and return ductwork between fan discharge, or heating unit discharge, and room diffuser/register; except omit insulation on return ductwork located in return air ceiling plenums.

b. Heating plenums and unit housings not pre-insulated at factory.

2. Insulate each ductwork system specified above with the following type and thickness of insulation:

a. Flexible Fiberglass: 2" (50 mm) thick.

D. Kitchen Hood Exhaust Ductwork: Insulate kitchen hood exhaust ductwork with the following type and thickness of insulation:

1. Certainteed FyreWrap EZ 1.5, zero clearance insulation, or equivalent to achieve a 2 hour fire rating.

3.4 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold equipment:

a. Drip pans under chilled equipment

2. Insulate each item of equipment specified above with the following type and thickness of insulation:

a. Flexible Elastomeric: 2" (50 mm) thick for surfaces above 35°F (2°C) and 3" (75 mm) thick for surfaces 35°F (2°C) and lower.

B. Hot Equipment (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot equipment:

a. Boilers (not pre-insulated at factory)

b. Condensate receivers

c. Heating air separator

d. Hot water pumps

e. Condensate pumps

f. Metal flue outlet of each boiler

2. Insulate each item of equipment specified above with the following type and thickness of insulation:

a. Rigid Fiberglass: 2" (50 mm) thick, except 3" (75 mm) thick for low-pressure boilers.

C. Breeching, and Stack Insulation:

1. Application Requirements: Insulate the following breechings and stacks:

a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.

b. Stacks from bottom to top except for factory insulated stacks.

2. Insulate each breeching and stack exhaust specified above with one of the following types and thicknesses of insulation:

a. Rigid Fiberglass: 3-1/2" (89 mm) thick.

3.5 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

1. Insulation materials shall not be applied until systems have been witnessed, documented, and submitted to meet pressure testing requirements indicated throughout these specifications.

B. Install insulation on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Staples shall not be used.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Provide factory molded insulation or pre-fabricated fittings for all valves, fittings, unions, etc. Valve handles must be extended by the mechanical contractor to accommodate the insulation without reducing the thickness or integrity of the valve insulation.

G. All water test ports shall be accessible from the insulation. In addition, water flow measuring stations require access from insulation to verify sizes and model.

H. Extend piping insulation without interruption through pipe hangers, walls, floors and similar piping penetrations, except where otherwise indicated.

I. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" (75 mm) wide vapor barrier tape or band over the butt joints. If using pipe hangers, follow manufacturer's instructions for installation.

J. All exposed pipe insulation, including fittings, above 8'- 0" (2400 mm - 0 mm) of finished floor shall have 8 oz. (227 g) fire retardant canvas cover neatly cut and parted seams shall be sealed.

K. All exposed pipe insulation, including fittings, within 8' - 0" (2400 mm - 0 mm) of finished floor or within a stairwell, shall be provided with aluminum or PVC protective covers. All edges shall be hemmed and all seams shall be concealed.

L. All exterior piping shall be provided with an embossed aluminum jacket.

M. For all insulated piping 2-1/2" (63 mm) and larger, provide insulated saddles as follows:

1. For heating water (up to 250ºF), provide the following:

a. Minimum 3.5 pcf, non-compressive, rigid, phenolic foam insulation. Fire and smoke rating shall be 25/50 or below per ASTM 84.

b. The phenolic foam system shall have a K factor of 0.16 at a mean temperature for 75ºF (24ºC) and comply with ASTM Standard C1126.

c. Provide visible inspection sticker at the bottom of each saddle.

d. Pipe insulation saddles shall be Tru-Balance CoolDry Saddles as manufactured by Buckaroos, Inc. or equivalent.

e. Armacell Armafix Pipe Hangers may be used for cold water piping with flexible elastomeric insulation.

3.6 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

1. Insulation materials shall <u>not</u> be applied until systems have been witnessed, documented, and submitted to meet pressure testing

requirements indicated throughout these specifications.

2. Install insulation materials with smooth and even surfaces.

3. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

4. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage. Seal all joints with vapor barrier material.

5. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

B. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound lining has been specified.

C. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

D. All balancing damper handles shall be exposed and visible on externally insulated ductwork.

3.7 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

1. Insulation materials shall <u>not</u> be applied until systems have been witnessed, documented, and submitted to meet pressure testing requirements indicated throughout these specifications.

2. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

3. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

4. Do not apply insulation to equipment, breechings, or stacks while

equipment is operating.

5. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

6. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

7. If using fiberglass insulation, cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2" (50 mm). Apply over vapor barrier where applicable.

8. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

9. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

B. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by manufacturer.

3.8 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division-23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

3.9 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.

END OF SECTION

SECTION 23 0800 - COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 COMMISSIONING AGENCY

A. The commissioning agency (CA) has been contracted directly with the owner for this project. The CA has overall responsibility for planning and coordinating the commissioning process. However, commissioning involves all parties to the design and construction process, including the contractor.

1.2 CONTRACTOR RESPONSIBILITY

A. This Section of the specifications defines the contractor's responsibilities with respect to the commissioning process. Each contractor and sub-contractor shall review this Section, and shall include in their bids for carrying out the work described, as it applies to each Division and Section of these specifications, individually and collectively.

B. The Mechanical Contractor shall act as the General Contractor as it relates to work required to support commissioning activities. All references to "General Contractor" throughout this specification section shall apply to the Mechanical Contractor. As used in this specification section, the terms "General Contractor" and "Mechanical Contractor" shall be interchangeable.

1.3 DESCRIPTION OF WORK

A. The purpose of the commissioning process is to provide the owner/operator of the facility with assurance that the mechanical systems have been installed according to the contract documents, and operate within the performance guidelines set out in the design intent documents (DID) and these specifications. The CA will provide the owner with an unbiased, objected view of the system's installation, operation, and performance. The commissioning process does not take away or reduce the responsibility of the installing contractors to provide a finished product, installed and fully functional in accordance with the contract documents.

B. Commissioning is intended to enhance the quality of system start-up and aid in the orderly completion and transfer of systems for beneficial use by

the owner. The CA will be the leader of the commissioning team, planning and coordinating all commissioning activities in conjunction with the design professionals, subcontractors, manufacturers, and equipment suppliers.

C. The General Contractor, all Division-23 sub-contractors, and the Electrical Contractor shall be responsible for cooperating, and coordinating their work, with the CA. They shall also be responsible for carrying out all the physical activities required for installation of components and systems, and operating them during the commissioning process as required in this Section.

1.4 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions, general mechanical provisions and applicable Division 23 and 26 specification sections, apply to work of this section.

1.5 REFERENCES

A. Associated Air Balance Council Commissioning Guideline.

PART 2 - PRODUCTS

2.1 HVAC SYSTEMS TO BE COMMISSIONED

A. HVAC systems installed under this contract are to be inspected, tested signed off as complete and operational, and operated for commissioning agency verification as described in Part 3 of this Section. This includes, but is not necessarily limited to the work listed for each system. The foregoing includes all the following:

1. Hot Water Piping Systems: Work includes installation inspections and checks; pressure tests and documentation; expansion tanks; confirmation of flow balancing completion; seismic restraints installation certification.

2. Duct and Air Handling Systems: Work includes installation inspections and checks; confirmation of flow balancing completion; leak testing as applicable; seismic restraints installation certification.

3. Refrigeration Compressor/Condensing Unit(s): Work includes installation inspection and checks (including seismic restraints

installation certification); checkout and startup by manufacturer's representative as specified; documented performance measurements including capacity, evaporator and condenser pressures, motor current draw, and controls operation.

4. Exhaust Fans and Destratification Fan: Work includes checks on installation (including seismic restraints, dampers and other accessories), rotation sound levels, motor current draw, and airflows and pressures.

5. Boiler(s): Work includes installation inspections and checks (including seismic restraints installation certification); boil out and chemical treatment; checkout and startup by manufacturer's representative; documented performance measurements including combustion efficiency, capacity test, burner and controls operation.

6. Pumps: Work includes documented checks on alignment, rotation, motor current draw, flows and pressures.

7. Air Handling Units: Work includes installation inspections and checks (including seismic restraints installation certification); checkout and startup by manufacturer's representative as specified; documented capacity tests for heating, cooling, air flow and static pressures; operation of all controls; sound levels.

8. VRF Compressor/Condensing Unit(s): Work includes installation inspection and checks (including seismic restraints installation certification); checkout and startup by manufacturer's representative as specified; documented performance measurements including capacity, evaporator and condenser pressures, motor current draw, and controls operation.

9. VRF Indoor Units: Work includes installation inspections and checks; performance and controls checks (including seismic restraints installation certification).

10. Ductless Split Systems: Work includes installation inspections and checks; performance and controls checks (including seismic restraints installation certification).

11. Radiant Flooring System: Work includes installation inspections and checks.

12. Electric Heaters: Work includes installation inspections and checks.

13. Mechanical Piping Systems: Work includes installation inspections and checks; pressure tests and documentation; confirmation of

seismic restraints installation certification.

14. Direct Digital Controls System: Work includes inspections and checks of installation and operation of all devices; complete operation of all controls sequences, in coordination with commissioning of all controlled systems.

B. The General Contractor shall be responsible for carrying out all work required for commissioning these systems that is defined as a contractor responsibility in Part 3 of this Section.

2.2 SYSTEM VERIFICATION CHECKLISTS

A. The CA will develop system verification checklists for mechanical and plumbing equipment and controls:

2.3 FUNCTIONAL PERFORMANCE TEST CHECKLISTS

A. The CA will develop functional performance test checklists for mechanical and plumbing equipment and controls:

2.4 MEMBERS OF THE COMMISSIONING TEAM

A. The commissioning team will consist of representatives of the following:

1. Owner
2. End user (if applicable)
3. Architect
4. Mechanical design engineer
5. Electrical design engineer
6. Commissioning agency (CA)
7. General contractor/Mechanical (Division-23) contractor (M)
8. Electrical (Division-26) contractor (E)
9. Controls contractor (ATC)
10. Sheet metal contractor

11. Testing, adjusting and balancing agency (TAB)

12. Owner's O & M staff

B. During the commissioning process, participation of team members will generally be required as noted in the following table (with abbreviations as noted in brackets in the preceding list of team members). The mechanical contractor, indicated by "M", includes all mechanical sub-contractors or suppliers whose participation is required for commissioning a particular system or piece of equipment.

	TEAM MEMBERS				
EQUIPMENT/SYSTEM DESCRIPTION	CA	M	TAB	ATC	E
Boilers	X	X	X	X	X
Pumps	X	X	X	X	X
DOAS Units	X	X	X	X	X
VRF Systems	X	X	X	X	X
Exhaust fans	X	X	X	X	X
Destratification fans	X	X		X	X
Refrigerant compressor/condensing unit	X	X		X	X
Ductless Split Systems	X	X		X	X
Electric Heaters	X	X			X
Radiant floor heating system	X	X	X	X	

PART 3 - EXECUTION

3.1 COMMISSIONING RESPONSIBILITIES – NON-CONTRACTOR TEAM MEMBERS

A. Introduction: As noted in Part 2, a multi-disciplinary team carries out the commissioning. The commissioning responsibilities of some non-contractor team members during the construction and acceptance phases of the

project are provided here for information, to provide some context for the overall process.

B. Commissioning Agency Responsibilities: The commissioning agency will:

1. Plan, organize and implement the commissioning process as specified herein;

2. Prepare the commissioning plan, and ensure its distribution for review and comment;

3. Revise the commissioning plan as required during construction;

4. Chair commissioning meetings, and prepare and distribute minutes to all commissioning team members, whether or not they attended the meeting;

5. In conjunction with the General Contractor, coordinate commissioning activities among all contractors, sub-trades and suppliers;

6. Monitor system verification checks, and ensure the results are documented as the checks are done;

7. Monitor controls point-to-point checks done by the controls contractor, and ensure the results are documented as the checks are done;

8. Observe all start-ups and initial system operation tests and checks;

9. Direct the contractors to operate equipment and systems as required to ensure that all required functional performance tests are carried out for verification purposes;

10. Witness all functional performance tests and document the results;

11. Prepare and submit a Commissioning Report which documents all checks and tests done throughout the commissioning process, and the results obtained from each; and

12. Ensure all required O & M manuals, instructions and demonstrations are provided to the Owner's designated operating staff.

C. Mechanical Engineer Responsibilities:

1. The Mechanical Engineer will review the Commissioning Plan, and will participate, as appropriate, in on-site commissioning meetings.

2. During the acceptance phase of the commissioning process, the Mechanical Engineer may be on site to review commissioning documentation, to witness functional performance tests, and to analyze the installation and its performance.

D. Owner's Responsibilities:

1. The Owner will ensure the availability of operating staff for all scheduled instruction and demonstration sessions. This staff will possess sufficient skills and knowledge to operate and maintain the installation following attendance at these sessions.

2. The Owner will also ensure the appropriate involvement of the Electrical Engineer, Architect, and any other consultants as required, in the commissioning process.

3.2 COMMISSIONING RESPONSIBILITIES – GENERAL CONTRACTOR

A. The General Contractor has the responsibility to ensure the overall completion of the work. In this regard, he shall:

1. Participate as required in the HVAC commissioning process,

2. Ensure the mechanical subcontractors perform all assigned HVAC commissioning responsibilities as specified in 3.3,

3. Ensure the testing, adjusting and balancing agency performs HVAC commissioning responsibilities as listed in 3.4,

4. Coordinate with the Electrical Contractor to ensure they perform all assigned HVAC commissioning responsibilities as specified in 3.6,

5. Ensure the cooperation and participation in the HVAC commissioning process of all other sub-contractors as applicable.

B. The General Contractor shall assign a representative to the commissioning team, and submit the person's name to the commissioning agency, within one (1) month of the award of the contract. The representative shall have the authority to make decisions on behalf of the General Contractor as they relate to the organization and scheduling of HVAC commissioning. The representative shall facilitate communications among all contractors and suppliers and other commissioning team members, and shall foster the necessary cooperative action. One specific responsibility shall be to attend commissioning meetings, and ensure action items arising from them are attended to as required to allow the commissioning process to proceed

on schedule.

C. In the event that any scheduled equipment or system start-ups or functional performance tests are terminated because the CA or Mechanical Engineer discover deficient or incomplete work, or due to the non-attendance of required contractor or supplier personnel, the contractor or sub-contractors responsible for the termination shall also be responsible for paying reasonable costs of time and travel expenses of any or all of the following representatives who were physically present for the purpose of witnessing the start-up or the FPT: the CA, the Mechanical Engineer, the Electrical Engineer, and the Owner. The Owner may provide a statement to the General Contractor identifying the specific activity that was terminated, the scheduled date, and a list of those in attendance, along with their reasonable time and travel expense costs.

3.3 COMMISSIONING RESPONSIBILITIES – DIVISION-23 (MECHANICAL) CONTRACTOR

A. The mechanical contractor, and all the sub-contractors and suppliers within Division -23, shall cooperate with the commissioning agency (CA), and other commissioning team members, to facilitate the successful completion of the commissioning process.

B. The Contractor shall assign a representative to the commissioning team, and submit the person's name to the commissioning agency, within one (1) month of the award of the contract. The representative shall have the authority to make decisions on behalf of the mechanical contractor as they relate to the organization and scheduling of HVAC commissioning. The representative shall ensure communications between Division-23 contractors and suppliers and all other commissioning team members, and shall foster the necessary cooperative action. One specific responsibility shall be to attend commissioning meetings, and ensure action items arising from them are attended to as required to allow the commissioning process to proceed on schedule.

C. The Mechanical Contractor, and all mechanical sub-contractors and suppliers, shall cooperate with the Commissioning Agency in carrying out the HVAC commissioning process. In this context, the Mechanical Contractor shall:

1. Each contractor and sub-contractor in this division shall include in their quotes the cost of participating in the commissioning process as specified herein.

2. Ensure the automatic temperature controls (ATC) contractor performs HVAC commissioning responsibilities as listed in 3.5.

3. Provide instruction and demonstrations for the Owner's designated operating staff, in conjunction with the Commissioning Agency and Mechanical Engineer, and with the participation of qualified technicians from major equipment suppliers and the controls contractor.

4. Include requirements for submittal data, O & M data, and training information in each purchase order or sub-contract written.

5. Ensure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, and water treatment as applicable.

6. Ensure participation of major equipment manufacturing in appropriate start-up, testing and training activities.

7. Attend HVAC commissioning meetings scheduled by the CA.

8. Notify the CA a minimum of two (2) weeks in advance of scheduled equipment and system start-ups, so that the CA may witness system verifications, and equipment and system start-ups.

9. Provide sufficient personnel to assist the CA as required during system verification and functional performance testing.

10. Prior to start-up, inspect, check and confirm the correct and complete installation of all equipment and systems for which system verification checklists are included in the commissioning plan. Document the results of all inspections and checks on the checklists and sign them. If deficient or incomplete work is discovered, ensure corrective action is taken and re-check until the results are satisfactory and the system is ready for safe start-up.

11. Notify the CA a minimum of two (2) weeks in advance of the time for start of the TAB work. Attend the initial TAB meeting for review of the TAB procedures.

12. Provide equipment and systems start-up resources as specified and required. If during an attempted equipment or system start-up, deficient or incomplete work is discovered that would preclude safe operation, the start-up shall be aborted until corrective action has been taken. Ensure such action is taken and verified before re-scheduling a new start-up. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 of the Section.

13. Carry out performance checks to ensure that all equipment and

systems are fully functional and ready for the CA to witness formal functional performance tests (FPTs).

14. Operate equipment and systems for FPTs in accordance with the commissioning plan and as directed by the commissioning agency. If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the FPTs will be stopped by the CA. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section. Ensure that all corrections necessary for full and complete system operation as specified are completed; then with the ATC contractor and other applicable sub-contractors, carry out functional performance checks to confirm correct operation before applying to the CA to reschedule the FPTs for the system in question.

15. Prepare preliminary schedule for mechanical system orientation and inspections, O & M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up TAB, and task completion for use by the CA. Update schedule as appropriate throughout the construction period.

16. Attend Initial O & M staff training session.

17. Conduct mechanical system orientation and inspection at the equipment placement completion stage.

18. Update drawings to as-built condition and review with the CA.

19. Gather O & M data on all equipment, and assemble in binders as required by the commissioning specification. Submit to CA prior to the completion of construction.

20. Participate in, and schedule vendors and contractors to participate in the O & M staff training sessions as set up by the CA.

21. Provide written notification to the CA that the following work has been completed in accordance with the contract documents and the equipment, systems and sub-systems are operating as required.

    a. HVAC equipment including all fans, air handling units, ductwork, dampers, terminals and all Division-23 equipment.

    b. Refrigeration equipment, pumping systems and heat rejection equipment.

c. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.

d. Seismic restraints installed to specification; a certification from the seismic restraint engineer meets this requirement.

e. Non-dedicated systems using the air handling units for smoke control.

f. Fire detection and smoke detection devices furnished under other divisions of the specification as they affect the operation of the smoke control systems.

g. That the building control system is functioning to control mechanical equipment and smoke control systems as specified.

22. Provide a complete set of as-built drawings and O & M manuals to the CA.

3.4 COMMISSIONING RESPONSIBILITIES – TAB AGENCY

A. With respect to HVAC commissioning, the TAB agency shall:

1. Include costs for HVAC commissioning requirement in the quoted price.

2. Attend commissioning meetings scheduled by the CA prior to, and during, on-site TAB work being done.

3. Submit proposed TAB procedures to the CA and Mechanical Engineer for review and acceptance.

4. Attend the TAB planning meeting scheduled by the CA. Be prepared to discuss the procedures that shall be followed in testing, adjusting and balancing the HVAC system.

5. At the completion of the TAB work, submit the final TAB report to the General Contractor, with copies to the Owner, CA and Mechanical Engineer.

6. Participate in verification of the TAB report by the CA for verification of diagnostic purposes. This will consist of repeating a sample (normally 10% to 20%) of the measurements contained in the TAB report as directed by the CA.

7. Participate in O & M personnel training sessions as scheduled by the CA.

3.5 COMMISSIONING RESPONSIBILITIES – CONTROLS CONTRACTOR

A. With respect to HVAC commissioning, the controls contractor shall:

1. Include cost for commissioning requirements in the quoted price.

2. Review design for controllability with respect to equipment selected for the project:

a. Review and confirm in writing that a proper hardware specification exists to permit functional performance testing as required by specification and sequence of operation.

b. Review and confirm in writing that proper safeties and interlocks are included in design.

c. Ensure the proper sizing of control valves and actuators, based on design pressure drops. Ensure that control valve authority will result in capacity control as specified. Include valve sizing and authority information in submittal to Mechanical Engineer.

d. Ensure the proper sizing of control dampers. Ensure damper authority to control air flows as specified. Review and confirm in writing proper damper positioning for mixing to prevent stratification. Ensure correct actuator vs. damper movement for smooth operation. Include damper sizing, control authority and actuator selection data in submittal to Mechanical Engineer.

e. Ensure the proper selection of sensor ranges, and include data with submittal to Mechanical Engineer.

f. Clarify all questions concerning sequences of operation with the Mechanical Engineer.

3. Attend commissioning meetings scheduled by the CA.

4. Provide the following submittals to the CA for review:

a. Hardware and software submittals.

b. Control panel construction shop drawings.

c. Diagrams showing all control points, sensor locations, point names, actuators, controllers and where necessary, points of access, all superimposed on diagrams of the physical equipment.

d. Narrative description of all control sequences for each piece of equipment controlled.

e. Logic diagrams showing the logic flow of all control sequences.

f. A list of all control points, including analog inputs, analog outputs, digital inputs and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.

g. A complete control language program listing including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should also explain individual math or logic operations that are not clear from reading the software listing.

h. Hardware operation and maintenance manuals.

i. Application software and project applications code manuals.

5. Inspect, check, and confirm the proper installation and performance of controls/BAS hardware and software provided by others.

6. Integrate installation and programming scheduling with construction and commissioning schedules.

7. Inspect, check and confirm the correct installation and operation of input and output field points and devices through documented and signed off point-to-point checkouts.

8. Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system, in accordance with the O & M staff training program in the commissioning plan.

9. In conjunction with the mechanical contractor, demonstrate system performance to the CA including all modes of system operation (e.g. occupied, unoccupied, emergency) during the functional performance tests (FPTs). If improper functionality, incomplete work,

or other deficiencies affecting system performance are discovered, the FPTs will be stopped by the CA. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section.

10. Provide control system technician to assist during system verification and functional performance testing.

11. Provide support and coordination with TAB contractor on all interfaces between controls and TAB scopes of work. Provide, at no addition cost to the TAB and commissioning agencies, all devices, such as portable operator's terminals and all software for the TAB agency to use in completing TAB procedures.

3.6 COMMISSIONING RESPONSIBILITIES – ELECTRICAL (DIVISION-26) CONTRACTOR

A. With respect to HVAC commissioning, the electrical contractor shall:

1. Include cost for HVAC commissioning requirements in the quoted price.

2. Review design with respect to providing power to the HVAC equipment:

a. Verify that proper hardware specifications exist for functional performance and sequence of operation required by specification.

b. Verify that proper safeties and interlocks are included in the design of electrical connections for HVAC equipment.

3. Annual commissioning meetings scheduled by the CA.

4. Schedule work so that required electrical installations are completed, and systems verification checks and functional performance tests can be carried out on schedule.

5. Inspect, check and confirm in writing the proper installation and performance of all electrical services provided.

6. Provide electrical system technicians to assist during system verification and functional performance testing as required by the CA.

END OF SECTION

SECTION 23 0900 - AUTOMATIC CONTROL SYSTEMS (ELECTRIC-ELECTRONIC)

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: The extent of automatic controls work is indicated on the drawings and schedules and by the requirements of this Section, and all other Division-23 sections. The work includes, but is not limited to the following:

1. The provision of a complete and operational control system, including all devices necessary to perform the functions herein described or indicated on the drawings.

2. The provision of 120 and 208 volt line voltage and 5 and 24 volt low voltage wiring and conduit types shall be installed in accordance with Division-26 of these specifications.

3. The ATC contractor shall furnish and install all electrical wiring and conduit from power source, including termination, to all required ATC related power connections including, but not limited to, DDC controllers (provide low voltage controllers for air terminal units including transformers and disconnect switches as required), sensors, valve and damper actuators (including smoke dampers), air flow monitors, ATC panels, etc. The ATC contractor shall obtain a separate electrical permit as required by the local authority. The ATC contractor shall be wholly responsible for all power requirements necessary for a complete installation from the power source to all ATC related connections. The intended power source shall be as indicated on the electrical plans. All electrical work shall be installed in accordance with Division-26 of these specifications.

4. The ATC contractor shall interface with fire alarm devices as required to accomplish equipment shutdown, alarms, etc. indicated in sequences.

5. The ATC contractor shall coordinate and verify that all controllers, devices, and accessories are provided as required to accomplish all control functions and sequences indicated in the contract documents. Where control related devices are not provided by an equipment manufacturer, it shall be the responsibility of the ATC contractor to provide the control devices required to accomplish the functions and sequences indicated.

6. All drilling, cutting and patching associated with the installation of control systems.

B. Types: Provide automatic control systems of the following types:

1. Direct Digital Control (DDC) with electric actuation of valve and damper actuators.

2. The automatic temperature control system shall include remote interface and web access capability. All building management system control features including, but not limited to, points, alarms, scheduling, graphics, trending, etc. shall be available for control and monitoring through web access as well as remote interface (coordinate exact location with the using agency, where applicable).

1.2 QUALITY ASSURANCE

A. Systems Engineering: The systems engineering phase shall include the selection and integration of components into a complete system which will meet the performance and prescriptive requirements of the Contract, together with drawings, specifications, descriptions of operation, diagrams and other materials listed under "Submittals" paragraph of this Section.

B. Testing and Adjusting During and After Installation:

1. The testing and adjusting includes the submission of a test plan which shall describe in detail the method by which each component, subsystem, and system will be tested, calibrated, adjusted, and retested after installation in accordance with the specified sequences of operation and other characteristics of the control system. A report on test results, including set points and operating ranges of all components shall be submitted.

2. The testing specified in this paragraph shall not replace the testing specified in "Commissioning Tests and Verification" article of this Section.

C. Commissioning Testing and Verifications: The final phase of the quality assurance program of the project is the commissioning testing and verifications. This phase is to assure that the project is fully completed and that the systems are performing in accordance to specifications from end to end of the control systems. Demonstrations of the automatic control systems to the commissioning team in accordance to the requirements specified in Part 3 of this Section are required. A report on test results,

including set points and operating ranges of all components, shall be submitted.

D. Testing: The testing phase of quality assurance includes the submission of a test plan which shall describe in detail the method by which each component, subsystem, and system will be tested, calibrated and retested after installation to perform in accordance with the specified sequences of operation and other characteristics of the control system.

E. Reporting and Demonstration: This phase shall include the submission of a written report describing the "actions taken during the testing" phase, and including the set points and operating ranges of all equipment and a demonstration that the system performs in accordance with contract requirements.

F. Operating Instructions and Training: This phase of quality assurance includes the training of operating personnel utilizing written operating instructions prepared and approved under the "Submittals" paragraph of this Section, and the mounting of laminated control diagrams where directed.

G. Maintenance Manuals: This phase includes the submission of four hard bound copies of all manufacturers' cuts, maintenance and operating instructions, test reports and demonstration material, copies of control diagrams, and copies of the manufacturers' certifications.

1.3 SUBMITTALS

A. Shop Drawings: For each system to be controlled, prepare a drawing which includes a system flow diagram, control diagram, sequence of operation and schedule of components. Control diagrams shall be complete with end-to-end connections of piping and wiring from component terminal.

B. Manufacturer's Data: For each manufactured device or subsystem submit manufacturers' specifications and printed photograph of the proposed device or subsystem. Include engineering descriptions, principle of operation and application, and proposed model, style or size clearly indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The automatic temperature controls shall be furnished, installed, commissioned and warranted by one of the following acceptable providers:

1. Johnson Controls, Inc. - Factory Branch Office

2. Siemens Building Technologies - Factory Branch Office

3. Honeywell – Factory Branch Office

B. No distributors, wholesalers or manufacturers' representatives other than those listed above will be acceptable. In addition, manufacturers not listed above will not be acceptable.

2.2 SYSTEMS INTEGRATION

A. Control Loop Characteristics: Carefully evaluate the characteristics of each control loop, the time constants, equipment characteristics, control accuracy, and reliability and provide a system which will operate smoothly, without hunting, and within the accuracies specified.

B. System Components: Select components including sensors, transmitters, controllers, control devices, actuators, and instrumentation considering such factors as hysteresis, relaxation time, span, limits, and response time.

2.3 CONTROLLERS

A. General: Provide electric or electronic controllers for each local control loop.

1. Provide controllers with local adjustable setpoint, adjustable proportional band for analog controllers or adjustable differential for two position controllers.

2. Provide adjustable secondary input authority for dual input controllers with remote setpoint adjustment.

3. Provide integral or test connections for measuring input and output signal.

B. Electric/Electronic System Characteristics: Provide a system of control

which shall have all of the following system characteristics. Systems which do not conform to all of the following requirements will not be acceptable.

1. The system shall consist of multiple, field adjustable controllers. The controller, power supplies, input/output and other components specified, including metal cabinet will be referred to as a "Field Panel."

2. The field panel shall be capable of performing its assigned local loop control and other functions as a standalone unit. It shall perform all specified local loop control functions without interaction to other field panels, except for shared functions such as central time programs, heating-cooling changeover, etc.

3. The field panel shall utilize control algorithms that permit proportional, integral, and derivative control as required. Control algorithms shall permit one, two or three mode control as specified or indicated on the drawings.

4. Each field panel shall be capable of handling multiple control loops, with one or more controllers.

5. The system shall utilize industry standard sensors.

6. The field panel shall provide both analog and binary output control. Analog outputs shall be compatible with industry standard transducers. Provide a modulating analog output control signal. Binary output control commands shall be implemented through interposing control relays.

7. Field panels shall be of modular construction. The system shall utilize interchangeable components. The modular construction of the system shall permit quick repair, ease of expansion, and the use of standard controls.

8. Each field panel with sensors and controlled devices shall be capable of automatic, unattended restart in the event of electrical power failure. In the event of electrical power failure all controlled devices shall move to their predetermined "normal" positions. By normal, it is meant that spring-close valves shall close, spring-open devices shall open, spring return devices will return and magnetically held devices will move to the position dictated by the force of gravity. Upon the restoration of electrical power, the field panel shall automatically restart and provide control to its connected systems after power failures of up to 72 hours.

9. The field panel operating system shall reside in nonvolatile memory.

10. Site specific application data, setpoints and operator entered data shall be stored in volatile memory.

11. Nonvolatile memory shall include PROM, EPROM, EAROM, ROM and RAM.

12. The preceding terms describe a class of solid state semi-conductor memories manufactured with LSI (large-scale-integration) techniques. These terms are expanded as follows:

    a. PROM - Programmable Read Only Memory

    b. EPROM - Erasable PROM

    c. EAROM - Electrically Alterable ROM

    d. ROM - Read Only Memory

    e. RAM - Random Access Memory

C. Field Panels: Provide field panels as follows.

1. Each field panel shall consist of a controller, power supplies, input/output modules, and other components specified.

2. Provide field panels where indicated. Provide additional controllers, if required, to support the control loops specified, the sequence of operations, number of monitoring points or other criteria to permit the field panel capacity to meet the specified functional requirements of the project.

3. Each field panel shall be capable of operation as a completely independent unit.

4. Each field panel or controller shall include its own operator's keypad or other means of adjustment on site by the operator.

5. Each field panel shall receive signals from industry standard sensors and input devices. Each panel shall have the capability to monitor the following types of inputs:

    a. Analog inputs: 4 to 20 mA and 0 to 10 V DC.

    b. Binary inputs: Dry contact closure and pulse accumulator.

c. Provide transducers and/or signal conditioning to adapt other sensor types.

d. Field panels that permit the direct connection of resistance type sensors will be acceptable if the system accuracy, data resolution, value accuracy and sensor interchangeability, comply with all other requirements of the specification.

6. The field panel shall directly control actuators and control devices. Each field panel shall be able to provide the following control outputs:

   a. Binary outputs: Contact closure

   b. Analog outputs: 4 to 20 mA, 0 to 10 V DC and 0 to135 OHM.

   c. Systems that do not provide direct analog outputs will be acceptable providing that they generate the specified output signal through transducers.

7. Each field panel shall perform control functions and other routines, specified under Sequences of Operation.

8. Each field panel shall accept binary inputs, on-off, open-close, or other two state data. Provide isolation and protection against input voltage up to 180 VAC peak.

9. Each field panel shall provide Binary Output by contact closures for momentary and maintained operation of field devices. Provide electromagnetic interference suppression on all output lines to limit transients to non-damaging levels. Provide isolation and protection against voltage up to 180 VAC peak. Provide contacts rated for 2 A at 24 VAC.

10. Each field panel shall be enclosed in a metal cabinet. The cabinet shall be constructed of 16 US gauge sheet steel, Provide sufficient access for wire and conduit to enter the cabinet. The cabinet shall have a hinge door and a pin tumbler lock. All field panel locks for the project shall be keyed alike. The cabinet shall be shipped to the project for installation without electronics. The electronics shall be added at the time of wire termination and system commissioning. All control wiring and system communications shall be electrically terminated inside the field panel.

11. Provide a 15A duplex receptacle inside or immediately adjacent to the field panel. The receptacle shall be energized when power is disconnected from the field panel.

12. Ground the field panel and power supply with a minimum No. 12 THHN unbroken ground wire to the building earth ground system. There shall be a maximum of 5 ohms measured between the ground at the field panel and the building ground system.

13. Provide a master electrical power disconnect switch inside the field panel to disconnect all external power to the cabinet for maintenance and repair. The disconnect switch shall not affect the duplex receptacle hereinbefore specified.

14. Provide screw type terminal strips in the field panel for the termination of all field wiring. Lay out terminal strips in a neat and orderly fashion and label each termination. All wiring entering the panel shall be routed through the panel wireways in a neat and workmanlike manner, properly tied or laced and terminated.

15. Provide conduit and wire to connect the field panel to the nearest adequate source of emergency electric power.

D. Wire/Cable Labeling: Label wire and cable as follows.

1. Label each cable and each conductor within 6 inches (150 mm) of the termination point. Cable and wire identification shall match the wiring identification shown on the installation and record drawings.

2. Wire identification labels shall be securely affixed to the wire and shall be of the preprinted type providing a durable vinyl or plastic covering over the printed lettering.

3. Wire identification through color coding, embossed label tape, paper tags attached with string and handwritten labeling will not be acceptable.

E. Transient Protection: Provide transient protection as required by the manufacturer.

F. System Accuracy: Provide system accuracy in accordance with the following.

1. Each local system shall maintain end-to-end accuracy for one year from sensor to controlled device for the applications specified.

2. Space temperature with a range of 50°F to 85°F (10°C to 29°C) plus or minus 0.75°F (.4°C) for conditioned space; 30°F to 130°F (-1°C to 54°C) plus or minus 1.0°F (.6°C) for unconditioned space.

3. Duct temperature with a range of 40°F to 140°F (4°C to 60°C) plus or

minus 1.0°F (.6°C).

4. Outside air (OA) temperature with a range of minus 30°F to plus 130°F (minus -1°C to plus 54°C) plus or minus 2.0°F; with a subrange of plus 30°F to plus 100°F (plus -1°C to plus 38°C) plus or minus 1.0°F (.6°C).

5. Water temperature with a range of 33°F to 100°F (1°C to 38°C) plus or minus 0.75°F (.4°C); the range of 100°F to 250°F (38°C to 121°C) plus or minus 2.0°F (1.2°C); and water temperatures for the purpose of performing BTU calculations using differential temperatures to plus or minus 0.5°F (.3°C) using matched sensors.

6. Pressure with a range for the specific application plus or minus 2.0 percent of range.

7. Flow with a range for the specific application plus or minus 3.0 percent of range, and flows for the purpose of BTU calculations to plus or minus 2.0 percent of range.

G. Accuracy and Stability: Equipment shall be selected for the appropriate range of the application. Equipment selected with ranges in excess of the application will be replaced at the Contractor's expense.

2.4 SENSORS

A. General: Provide analog sensors for temperature controllers. Provide sensors with an output signal that varies continuously with the sensed temperature, within a specified range, of the thermistor or resistance type.

B. Manufacturer: Temperature sensors shall be made by one manufacturer.

C. Space Sensors: Provide space or room sensors with base plates thru-bolted into masonry or wall studs, brushed cast aluminum or 16 gauge (1.6 mm) ground and polished Type 316 stainless steel covers.

D. Insertion Type: Stem or extended surface sensitive type with screw mounting plate and galvanized sheet steel insulation mounting box.

E. Immersion Type: Stem or tip sensitive type with threaded immersion well base.

F. Sensing Elements: Hermetically seal, except for bimetal type for room thermostats. Stem, tip or extended element shall be Type 304 stainless steel or annealed copper.

G. Casing: Casing shall be constructed of watertight, vibration-proof, heat resistant high strength phenolic or 316 stainless steel.

H. Sensor Wells: Provide 304 stainless steel, bronze, copper or monel machined wells, compatible with the immersion medium, and heat sensitive transfer material or liquid between sensor and well surface.

2.5 ELECTRONIC ANALOG SENSORS

A. Range: Sensors shall operate within the range of minus 30°F to plus 220°F (minus -34°C to plus 104°C) for heating, ventilating and air conditioning (HVAC) systems.

B. Accuracy: Provide electronic analog sensors with an accuracy of plus or minus 0.25°F (.14°C).

C. Time Constant Response: Provide sensors with a time constant response to achieve 60 percent of a step temperature change in six (6) seconds in air or water flowing at 3 feet per second (.9 m/s).

D. Interchangeability: Sensors of the same type shall be interchangeable without calibration.

2.6 PRESSURE SENSORS

A. Overpressure Protection: Provide pressure sensors impervious to instantaneous pressure changes of 150 percent of working pressure but not less than plus or minus 50 psig (340 kPa).

B. Adjustment: Provide sensors with external adjustable span, adjustable zero and pulsation suppression.

C. Finished Spaces: Conceal pressure sensors in recessed stainless steel housing with removable perforated brushed stainless steel cover.

D. Sensor Characteristics: Provide pressure sensors with the following characteristics:

1. Ambient Temperature: 40°F to 140°F (4°C to 60°C).

2. Isolation Valves: Provide pressure sensors with stainless steel needle isolation valves between each sensor and sensor pressure source. Provide differential pressure sensors with 3-valve manifold for isolation and nulling.

3. Provide switching type sensors with platinum alloy, silver alloy or gold

plated wiping contacts rated for the application, voltage and power levels.

4. Provide valved calibration taps adjacent to each pressure sensor for calibration.

2.7 STATIC PRESSURE ANALOG SENSORS

A. Types: Provide diaphragm sensors with solid state pre-amplifier electronic systems.

B. Characteristics: Provide analog sensors with the following characteristics:

1. Sensor span shall be not less than 150 percent and not more than 300 percent of the working pressure.

2. Accuracy shall be 0.5 percent of calibrated span including combined effects of linearity, hysteresis and repeatability.

2.8 DIFFERENTIAL PRESSURE ANALOG SENSORS

A. Types: Provide differential pressure analog sensors of the solid state pre-amplifier types for electronic systems.

B. Characteristics: Provide sensors with the following characteristics:

1. Sensor span not less than 150 percent nor more than 300 percent of the working differential pressure.

2. Accuracy of 0.5 percent of calibrated span, including combined effects of linearity, hysteresis and repeatability.

3. Pressure sensor shall withstand overpressure of not less than 200 percent working pressure and full vacuum underpressure without damage, changes in sensor accuracy or deformation.

2.9 DEW POINT AND RELATIVE HUMIDITY SENSORS

A. Dew Point Sensors: Provide analog salt-phase transition or dual cooled mirror type sensors with an accuracy of plus or minus 3°F (1.6°C) dew point over the range of 10°F to 100°F (-12°C to 38°C) dew point.

B. Relative Humidity Sensors: Provide analog precision resistance or hydro-mechanical gauge type relative humidity sensors, with an accuracy of plus or minus 2 percent of relative humidity over a range of

10 to 90 percent relative humidity.

C. Shields: Provide 316 stainless steel weatherhoods and shields to protect outdoor sensors from sunlight, snow, ice, wind and rain and provide fan powered aspirator complete with wiring if recommended by the manufacturer.

D. Indoor Covers: Sensors located in public spaces shall have brushed 16 gauge (1.6 mm) 316 stainless steel covers or recessed aspirating boxes with Allen head screw mounting plate.

2.10 THERMOSTATS

A. Types: Provide electronic thermostats which operate in an analog proportional or binary two-position mode as required by the sequence of operation.

B. Mounting: Mount thermostats in non-public spaces except room thermostats.

C. Electric Analog Thermostats: Provide electric analog thermostat with the following characteristics:

1. Sensor shall be of the bulb or capillary type which shall actuate a 135 ohm 3-wire potentiometer for 0-10 VDC, or 4-20 milliamp proportioning control action of balanced bridge motor actuators.

2. Sensor shall have adjustable setpoint range of not less than 80°F (27°C) throughout the range of 0°F to plus 250°F (-18°C to plus 121°C).

3. Adjustable proportional band ranges from 3°F to 25°F (-16°C to -4°C) and capillary length of not less than 5 feet (1500 mm) shall be provided.

D. Electric Two Position Duct and Immersion Thermostats: Provide thermostats with bimetal or bulb and capillary type sensor actuating one or more switching contacts.

1. Contact shall be rated for the imposed load or shall be a pilot duty type and provided with a control relay.

2. Thermostats shall have adjustable setpoint throughout the range 0°F to plus 250°F (-18°C to plus 124°C).

3. Differential shall be adjustable from 3°F to 10°F (-16°C to -12°C) for

each contact for refrigeration, boiler and industrial applications.

4. Fixed differential thermostats with differentials of 3 may be provided for On-Off control of unit heaters, ventilating fans and similar applications.

5. Provide capillary tubes in the 5 to 20 feet (1500 to 6000 mm) lengths to suit applications.

E. Freeze Protection Thermostats: Electric freeze protection thermostats shall be provided with capillary elements, and special purpose insertion elements not less than 20 feet (6000 mm) in length for the face of coils up to 80 square feet (7.4 m^2). Freeze protection thermostats shall have the following characteristics:

1. A freezing condition at any one foot length increment anywhere along the sensing element shall activate the thermostatic switch.

2. Switch shall require manual reset.

F. Weather Shields: Provide weather shields and outside air sensing elements with the following characteristics:

1. Mount elements and shields on the north face of the building or location out of direct sunlight.

2. Construct shields of 16 gauge (1.6 mm) 316 stainless steel with flanges bolted to a backplate with not less than four 1/4-inch (6 mm) diameter stainless steel bolts. Mount backplate to the building structure with expansion bolts.

3. Construct shields to inhibit solar effects. Construct shields in a rectangular box configuration with ventilating raintight louvers to preclude the entrance of snow, ice and rain. Design for crossflow and vertical air circulation.

4. Mount shields accessible for maintenance.

5. Seal wall penetration watertight.

2.11 PRESSURE CONTROLLERS

A. Types: Provide electric electronic pressure controllers of the analog or two- position type as required by the sequence of operation.

B. Analog Controllers: Provide controllers with proportional action plus integral and derivative control modes.

1. Provide sensing elements of the differential type measuring controlled medium and standard reference pressures.

2. Air static pressure controllers shall have slack diaphragms with standard ranges 0 to 6 inches water column (0 to 1500 Pa) and an adjustable proportional band range of 0.02 to 0.5 inches water column (5 to 125 Pa).

3. Sensing elements for duct applications shall be damped to preclude pulsation.

4. Water differential pressure controllers shall have a minimum range of 0 to 50 psig (0 to 345 kPa) or 0 to 250 psig (0 to 1725 kPa) as required by the application with adjustable proportional band of one to 25 psig (170 kPa). Sensing elements shall be diaphragm type with 3-valve manifold. Provide siphons and pressure snubbers.

2.12 ELECTRIC PRESSURE SWITCHES

A. Type: Provide bourdon tube or diaphragm type electric pressure switches with tamperproof adjustable set point and differential settings. Design switches for 200 percent overpressure and full vacuum underpressure without damage or accuracy impairment.

2.13 DAMPERS

A. Standards: Provide opposed blade and parallel blade factory fabricated dampers of extruded aluminum, galvanized steel or stainless steel with metallic anti-friction non-ferrous bearing in accordance with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) standards.

B. Types: Use parallel blade dampers in mixing chambers and plenums. Use opposed blade dampers for volume control, face and bypass dampers, smoke dampers, fan discharge, and variable air volume control.

C. Pressure Rating: For fan systems less than 10-inch water gauge (2490 Pa) static pressure, design and construct dampers to withstand a pressure of 150 pounds per square foot (7.1 kPa) without damage, leakage, flexure, or distortion.

D. Leakage: Maximum air leakage rate for all dampers shall not exceed 10 cubic feet of air per minute per square foot (50 L/s/m^2) at atmospheric pressure when closed against a 4-inch water gauge (1000 Pa) static pressure.

E. Operators: Damper operators shall have sufficient power to open and close the dampers and limit the leakage to the specified rate. Power wiring shall be extended to operator by this contractor.

F. Shafts and Bearings: Provide cadmium plated steel shafts in permanently lubricated bronze sleeve bearings or permanently lubricated ball bearings.

G. Blade Sizes: Reinforced or ribbed blades shall not exceed 8 inches (200 mm) in width nor 48 inches (1200 mm) in length.

1. Flat or unreinforced blades will not be acceptable.

2. Damper sections exceeding 4 feet (1200 mm) in width or 4 feet (1200 mm) in height shall be constructed with multiple frames and linkages.

H. Frames: Construct frames of factory welded galvanized steel hot dipped after construction or bolted extruded aluminum frames.

1. Dampers larger than 8 square feet (.7 m^2) in area shall have corner bracing gussets at each corner welded to the damper frame.

I. Linkages: Provide linkages to uniformly transmit damper operating forces to each damper blade.

1. Construct linkages of galvanized or cadmium plated steel or stainless steel.

2. Bearings and joints shall be ball and socket or sleeve bearings of brass, bronze or stainless steel, with plated bolts and locking nuts.

J. Seals: Provide mechanically attached elastomer or neoprene blade tip seal along the full length of each blade edge and flexible stainless steel seals along damper blade ends where the blades abut the frame. Adhesives or staples will not be acceptable.

K. Damper Mounting: Mount dampers to casings and ductwork in conformance with SMACNA standards. Provide welded or bolted galvanized steel structural supports for dampers larger than 20 square feet (1.9 m^2). Through bolt damper frames to structural supports.

2.14 AUTOMATIC VALVES

A. Standards: For low temperature hot water provide valves conforming to ANSI B16.15, "Cast Bronze Threaded Fittings," Class 125 copper bearing

steel, bronze, or ANSI B16.1, "Cast Iron Pipe Flanges and Flanged Fittings," Class 125 cast iron. Select valve pressure class minimum 150 percent of maximum working pressure.

B. End Connections: Provide valves with end connections as follows:

1. For low temperature hot water provide valves with flanged connections on sizes 2-1/2 inches (65 mm) and larger and threaded connections on valves 2 inches (50 mm) and smaller.

C. Small Water Valves (1" and Smaller): For valves controlling low pressure and low temperature hot water sizes one inch and smaller, bodies shall be bronze, cast iron or stainless steel with screwed, union or flare connections.

D. Valve Trim: Provide valve trim as follows:

1. Stems shall be 316 stainless steel.

2. Disk and stuffing boxes may be bronze or 316 stainless steel.

3. For all valves 1-1/2-inch (40 mm) and larger, stems, disks, and seats shall be 316 stainless steel.

4. All non-metallic parts of hot water valves shall be designed for minimum 250°F (121°C) or 100°F (38°C) above system design temperature.

5. Leakage: Control valves shall provide tight shut off in the closed position at 150 percent of maximum working pressure.

E. Valve Characteristics: Select valves to provide equal percentage control of water. Modulating valves shall have tapered plugs for water.

1. Butterfly valves that do not have "equal flow characteristics" will not be acceptable for modulating control.

2. For two-position, water application action, butterfly valves may be used, provided the differential pressure across the valve does not exceed 25 pounds per square inch (170 kPa).

F. Sizing: Provide valves of sizes indicated, or as herein specified.

1. Size water valves with a maximum differential pressure not greater 10 feet (480 Pa) or 1/2 the loss through the controlled apparatus, whichever is greater.

G. Actuators: Provide actuators, sized by the manufacturer, of sufficient size

and power to operate the valve under all conditions and to close the valve tight against maximum differential pressure.

1. Provide pilots for sequence operations, and cases where valve spring ranges have been increased to close off against system pressure.

2. Comply with requirements of "Actuators" paragraph of this Section.

2.15 ELECTRIC ACTUATORS

A. General: Provide electric motor driven actuators (operators) arranged "Fail Safe" in the event of power failure. Unless indicated otherwise, the fail position of each valve shall be the “last position” or “current position” at the time of failure. Design operators to be quiet in operation and function within a range 85 to 100 percent input power potential.

B. Electric Actuators: Provide hydraulic or gear type electric actuators.

1. When operated at rated voltage each actuator shall deliver the torque required for continuous uniform movement of the control device from limit to limit.

2. Provide an end switch to limit travel and design the actuator to continuously stroke without damage.

3. Operators shall function properly within a range of 85 to 120 percent of line voltage. For actuators with input power greater than 100 watts, gears shall be ground steel, oil immersed, shaft shall be hardened steel running in bronze, copper alloy or ball bearing and operator and gear trains shall be totally enclosed in dustproof cast iron, cast steel or cast aluminum housing.

4. Actuators with input power less than 100 watts may use fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings and pressed steel enclosures.

5. Two position actuators shall be of the single direction, spring return or reversing type.

6. Proportioning operators shall be capable of stopping at all points in the cycle and starting in either direction from any point.

7. Reversing and proportioning operators shall have limit switches to limit travel in either direction.

8. For actuators with greater than 400 watts input, provide totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

C. Damper Operator Mounting: Mount damper operators where accessible for maintenance.

1. If located outside the duct or casing, mount operators on a 14 gauge (2.0 mm) reinforced support plate arranged to allow insulation between the support plate and the face of the duct or casing.

2. Brace damper operators rigid to show no deflection or movement over the full range of the damper stroke.

2.16 CONTROL PANELS AND CABINETS

A. Local Panels and Cabinets: Provide local control cabinets for each air handling unit, automatically controlled equipment such as pumps, fans, heaters and convertors, or groups of such equipment in a single mechanical equipment room.

B. Standards: Construct panels in conformance with UL 50, "Cabinets and Boxes," or similar approved construction, with backbox, full-sized piano hinged face, stainless steel lockable latch, and secure to the building construction.

1. Internally mount all controllers, relays, terminal boards, and miscellaneous control devices, on a removable panel.

2. Flush mount in the door all indicators, selector switches, remote setpoint adjusters, and pilot lights.

3. Cabinet internals may be factory or field wired and piped. Wire shall be neat, braced, and strapped flat to present a neat appearance and to easily trace wiring and piping from one device to another.

4. Floor mounted panels shall be bolted to 1-1/2-inch by 1-1/2-inch (40 mm by 40 mm) structural support channel, bolted to the floor and braced at the top.

2.17 SYSTEM DIAGRAMS

A. Mounting: Mount control diagrams adjacent to each local control panel on a furniture steel extension either bolted to wall or to an extension of

the control cabinet structural support.

1. Control diagrams shall include system one-line diagram, system control diagram, sequence of operations, and schedule of control devices.

2. Diagrams shall be hermetically sealed in laminated 16 gauge (1.6 mm) plastic.

3. Diagrams shall be permanent, black on white background, not subject to fading when subjected to artificial or natural light. Diazo prints are not acceptable.

4. Diagrams shall represent the current, "as-built" status of the control system, after acceptance by the representative of the Owner.

5. Obsolete, out of date, or field modified diagrams shall be removed, and new current diagrams furnished.

6. Diagrams and devices on local control panels shall be identified with engraved phenolic nameplates, white on black, minimum 1/4-inch (6 mm) high block capital lettering, screwed or bolted to panel or mounting plate face. Adhesive attachments are not acceptable.

2.18 WIRING

A. General: Provide a complete system of electric wiring for temperature control apparatus including control power transformers and wiring to the transformer primary.

B. All wiring shall be installed in conduit. Refer to Division-26 section, "Raceways." MC cable is prohibited in all locations.

C. Wiring: Wire for low voltage AC shall be minimum 300 volt insulated copper No. 18 AWG or larger conforming to NFPA 70, Type MTW, THHN or TFFN, installed in accordance with Division-26 of these specifications.

1. For low voltage DC and an electronic circuit carrying less than 0.5 amperes, cables of two or more conductors not smaller than No. 18 AWG solid copper or No. 18 AWG solid copper if not shielded may be used in lieu of individual wires.

2. Cables carrying analog signals shall be shielded, if required by the manufacturer.

3. Cables shall be terminated in solder or screw type terminal strips.

4. Cables shall not be tapped at any intermediate points.

5. All wire shall be color coded or numbered for identification. Identify as indicated on shop drawings and "as-built" drawings.

6. Wire terminating in screw type terminal strips shall have pressure connectors conforming to UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors," or UL 486B, "Wire Connectors for Use with Aluminum Conductors."

7. Wire terminations without connectors or traveling pressure pads will not be accepted.

D. The contractor shall in no case combine control wiring (line or low voltage) with power wiring in the same conduit.

2.19 ACCESSORIES

A. Provide a PC based operator's workstation within the building at a location determined by the owner, including a flat screen monitor (minimum 21") and a color laser printer. Provide color graphics of all systems to be controlled, monitored and alarmed by the EMCS. Computer hardware and software shall be compatible with the most current version of the ATC vendor's software and graphics packages.

B. Provide a portable operating terminal for connection to the main DDC control panel. In addition, main panel shall be provided with modem connection.

2.20 EMERGENCY SHUT-OFF SWITCHES, CO SENSORS, AND NO2 SENSORS

A. Boiler shut-off switch shall be guarded, red toggle type, single pole, rated 20 amperes at 120V VAC. Switch shall be enclosed in a single gang outlet box with red coverplate and legend to read "EMERGENCY STOP". A nameplate shall be provided to indicate the equipment served. The contractor shall route 3/4" conduit and control wires from each switch to boiler control panel. Coordinate wiring type and quantity with boiler manufacturer. Coordinate connection point in boiler control panel with boiler manufacturer.

B. Provide emergency shut-off switches for all boilers indicated on the drawings at each exit from the mechanical room. Switches shall be located at the interior or exterior of the room as determined by the authority having jurisdiction.

C. Provide carbon monoxide (CO) sensors for wall and ceiling mounted applications. Sensors shall operate on low voltage 24V power supply. Accuracy must be plus or minus 2.5%. Operating range must be 0-250 ppm. EMCS shall monitor CO levels. CO sensors must be located based on coverage area so as to provide complete coverage of the entire Apparatus Bay as shown on the drawings. Refer to the mechanical control drawings for required equipment sequence steps for each CO level.

D. Provide nitrogen dioxide (NO2) sensors for wall and ceiling mounted applications. Sensors shall operate on low voltage 24V power supply. Accuracy must be plus or minus 2.5%. Operating range must be 0-10 ppm. EMCS shall monitor NO2 levels. NO2 sensors must be located based on coverage area so as to provide complete coverage of the entire Apparatus Bay as shown on the drawings. Refer to the mechanical control drawings for required equipment sequence steps for each NO2 level.

2.21 FLOW SENSORS

A. General: Provide sensors for measuring flow in piping and ductwork that are compatible with static pressure and differential pressure analog of the electronic controllers served.

B. Turndown: Provide sensors with an output characteristic which gives a continuous mathematical function over the full range of flow from maximum to minimum required.

C. See specifications, this section, for required air and/or water flow monitor measurement characteristics.

D. Provide all necessary power and control wiring as required for complete and operational flow measurement systems interlocked with the building EMCS.

2.22 AIRFLOW MEASUREMENT SYSTEMS (AIRFLOW MONITORS)

A. The airflow measurement system (AFMS), including airflow monitor, sensors, controllers, transmitters, etc., indicated on the plans shall be capable of continuously monitoring airflow rates at each measurement location. The system shall consist of one or more airflow measuring devices and a single microprocessor based transmitter. The number of sensing points shall be as per manufacturer's recommendation for the specified application. The AFMS shall not require recalibration or adjustment over the life of the equipment. If the technology provided is

vortex shedding or the pitot tube type the system shall be calibrated on a semi-annual basis during the construction phase through the end of the warranty. The manufacturer is responsible for all cost associated with recalibration.

B. Upon request, the manufacturer shall provide for approval and verification a written copy of the following:

1. 16 point NIST traceable report of calibration used for the reference standard.

2. UL/cUL 873 report listing the AFMS as a complete assembly.

3. Independent laboratory test report results of 100% survival rate in a 30 day saltwater and acid vapor test.

C. The AFMS shall produce a single, linear, analog output signal for airflow, which can be measured by the host control system. The system shall have the ability to perform self-diagnostics and automatic zeroing to adjust the signal to zero at pre-determined time intervals, which eliminates all output signal drift due to thermal, electronic and mechanical effects. In the event of sensor failure, the system shall ignore the failed sensor(s), average the remaining sensors and continue to operate.

D. The total accuracy from the airflow measurement to the host controls, including sensing point averaging error, the sum of the sensor and electronic (transmitter) errors, etc. shall not exceed +/-2% of reading at both minimum and maximum airflow rates based on the manufacturer's published performance specifications for all devices. In addition, total system performance including sampling error, shall not exceed +/-5% of actual airflow. The installed accuracy, in accordance with manufacturer's recommendations, without field adjustment shall be as follows throughout the operating range:

1. Ducts and plenums: +/- 3% of reading

2. Outside air intakes: +/-5% of reading

3. Fan inlets: +/- 10% of reading

E. The sensors and electronics shall operate over a temperature range of -20 to 120°F for ducted supply or return applications and -20 to 120°F for outside air applications. The sensors and electronics shall operate at a relative humidity range of 0 to 95% (non-condensing) for ducted supply and return applications and 0-99% (non-condensing) for outside air applications. Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the

NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of ±2% of reading over the entire calibrated airflow range of 0 to 5,000 FPM for ducted applications. Upon request, a working demos shall be provided to the design team to display that the system can work at low flows.

F. For standard applications, sensors shall be constructed of materials that resist corrosion due to moisture or salt in the airstream. Aluminum probes shall be provided. For laboratory exhaust applications, provide stainless steel sensors with stainless steel casing. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/2CL2P, UL/cUL listed cable rated for exposures from -67°F to 392°F (-55°C to 200°C) and continuous and direct UV exposure. Plenum rated PVC jacket cables are not acceptable. Devices that have electronic signal processing components on or in the sensor probe are not acceptable. Where the electronics are installed in a location exposed to potential wind driven rain or snow (including outside air plenum) provide a NEMA 4 enclosure for all electronics. In addition, a visual display shall be provided to illustrate airflow (CFM) and temperature. The transmitter must also be able to display individual sensor reading and each individual flow for each fan on a fan array.

G. Analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate; while the second output (AO2) shall be field configurable to provide one of the following: temperature, low and/or high airflow user-defined set point alarm, individual fan alarm (for fan arrays) or system status alarm.

H. Airflow measuring devices shall be UL listed as an entire assembly. The transmitter shall include fused protection.

I. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans for conformance with installed accuracy requirements. A written report shall be submitted to the consulting mechanical engineer if any measurement locations will not result in specified installed accuracy requirements.

J. Prior to purchase or installation of the air flow monitor (AFM), the Contractor and/or AFM Product Representative shall review each equipment and/or duct mounted location to verify suitability for installation. Should there be any discrepancy regarding installation or performance, the Contractor shall notify the Engineer immediately.

K. Provide all necessary power and control wiring as required for a complete and operational air flow measurement system interlocked with the building EMCS. Network communications RS 485 (BACnet MS/TP or

Modbus RTU) or Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) shall provide: the average airflow rate, temperature, high and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates (individual fan airflow rates for fan arrays) and individual sensor node temperatures. Individual node airflow rates and temperatures shall be available via the network with Lon.

L. Airflow measurement system manufacturers shall be limited to the following:

1. Ebtron (Gold)

2. Air Monitor Valo-probe with Veltron II transmitter

3. Tek Aire Vortek VT-5000

2.23 FLOW METER

A. Furnish and install flow meters where indicated on the drawings. Flow meter shall be a dual turbine insertion type flow sensor complete with all installation hardware necessary to enable insertion and removal of the flow meter without system shutdown. The dual turbine element shall have contra-rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Paddle type rotors will not be acceptable. Rotational sensing of each turbine shall be accomplished electronically by sensing impedance change and not with magnetic or photo-electric means.

B. The sensor shall have a maximum operating pressure of 400 PSI, minimum operating pressure of 180°F (optional 300°F peak) and a pressure drop of less than 1 PSI at 17 feet per second flow velocity. Flow sensor shall have a 175:1 turndown ration. Accuracy shall be $\pm$ 0.5% of actual reading at the calibrated typical velocity, and within $\pm$ 2% of reading from 0.4 to 20 ft/s (50:1 turndown). Each sensor shall be individually wet calibrated and tagged accordingly against a primary volumetric standard accurate to within 0.1% and directly traceable to the U.S. National Institute of Standards and Technology (NIST).

C. The sensor shall have integral analog outputs of 0-10 VDC and 4-20 mA linear to within $\pm$ 0.1% of calibrated span for connection to the EMCS. The sensor shall also include three (3) integral frequency outputs (top turbine, bottom turbine, average frequency) for diagnostic purposes and for connection to peripheral equipment (local display, BTU meter, etc.). All outputs shall be linear with flow rate.

D. The turbine elements shall be constructed of polypropylene (optional polysulfone) with sapphire jewel bearings and tungsten carbide shafts. The flow sensor shall be constructed of plated brass (optional 316 stainless steel with an aluminum electronics enclosure and gasketed cover) (optional weathertight enclosure).

E. Flow meter shall be Model F-1210 as manufactured by Onicon or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wiring and Conduit: Provide wiring and conduit to connect the automatic control system components for an operational system.

1. Provide wiring in accordance with requirements indicated in this section.

2. Run conduit in straight lines, parallel to the lines of the building, and rack on factory furnished mounting blocks attached to the building structure. Where run buried in slabs provide long sweep rigid conduit bends extending 6 inches (150 mm) above the slab at slab penetrations.

3. Do not bury or conceal wiring beneath building insulation.

4. Locate wiring clear of access doors, accessible ceilings, lighting fixtures, walkways, or any location subject to damage or abrasion.

B. Identification: Label or code each field wire at each end, and each controller and controlled device.

1. Identification shall be permanent, robust, not subject to fading, and flameproof.

2. Permanently mark terminal blocks at wire termination points.

3. Identify each control device with an engraved laminated phenolic nameplate, white on black, lettering not less than 1/8-inch (3 mm) height, on 1-1/2-inch (40 mm) by 1-inch (25 mm) tag and brass interlocked chain secured to the control device. Name shall correspond with identification on the shop drawings.

4. Identify sensors, controllers, relays, either mounted in local or central control panels, or remote mounted with a similar name tag as

specified above. Attach to or adjacent to controllers with stainless steel or brass screws or rivets. Adhesives will not be acceptable. Do not attach to removable controller covers.

C. Pipe Work: Mount strap-on sensors using helical screw stainless steel band clamp for strap-on thermostats, aquastats and other temperature switches on new piping for unit heaters and fan coil units after the pipe is cleaned to bright metal. Strap-on sensor may be used on piping up to 2-1/2-inch (65 mm) diameter. On pipe 3 inches (80 mm) and larger use pipe wells.

D. Pipe Wells: Install pipe wells above the horizontal to retain liquid heat transfer fluid in the well.

E. Valves: Install valves in piping with stems as vertical as possible but in no case less than 45 degrees from vertical. For soldered or welded connections, remove valve internals before mounting.

F. Electric Valves: Wire electric valves in accordance with NFPA 70 with not less than 2 feet (610 mm) of flexible liquidtight connector with watertight bushings at the valve actuator. Brace conduit to the building structure.

G. Pressure and Temperature Sensors: Install pressure and temperature sensors as follows.

1. Locate pressure and temperature sensing points sufficiently downstream from the control device to increase control loop time constant and minimize hunting.

2. Locate shut-off valves and 3-valve bypasses as specified in "Sensors" paragraph of this Section.

3. Locate sensors where accessible for maintenance and replacement.

4. Do not cover or conceal sensors with insulation.

H. Space Sensors: Install space sensors as follows.

1. Space sensor including space thermostats, aspirating thermostats, humidistats, pressure or differential pressure sensors shall be enclosed in cast brushed aluminum or 16 gauge (1.6 mm) brushed and ground stainless steel enclosures. Enclosures shall be tamperproof. Setpoint adjustment or settings shall not be visible or adjustable from outside sensor enclosure. Sensors shall be securely mounted and rigid.

2. Locate room thermostats and other room sensors approximately 48

inches (1200 mm) above the floor (or otherwise as required to meet the most current ADA guidelines) on inside wall where they will respond to average conditions in the space.

3. Sensors mounted on outside walls, if unavoidable, shall be mounted on factory made insulated brushed stainless steel bases.

4. Provide thermostat/sensor guards in all areas subject to potential damage. Thermostat/sensor guards shall be clear, impact resistant lockable plastic or approved equivalent. Thermostat/sensor guards shall be provided in the following areas and other similar type spaces subject to potential damage: gymnasium, multi-purpose rooms, fitness areas, activity rooms, mechanical rooms, electrical rooms, etc.

I. Air Handling Unit Temperature Indicators: For each factory assembled central station air handling unit and field erected air handling unit, provide temperature indicators in the following locations. In addition, unless indicated otherwise by the Owner, provide thermostat/sensor guards wherever students have access, including but not limited to: classrooms, corridors, cafeteria, media center, auditorium, etc.

1. Each outside air plenum.

2. Each return air plenum.

3. Each cooling coil inlet and discharge.

4. Each heating coil discharge.

5. Temperature indicators shall be so located that they may be read by an operator standing on the operator floor. Indicators more than 8 feet (2400 mm) above the floor shall be remote bulb type.

J. Duct Sensors: Select duct sensor locations to properly sense average air conditions, minimize vibration, avoid dead air spaces, and within velocity limits required by the manufacturer.

1. Provide velocity shields where required.

2. Securely mount or clamp averaging elements, maximum 3 feet (900 mm) on centers to the leaving side of coils and equipment. Insulate averaging elements from equipment and protect from vibration.

3. Provide separate duct flanges for each sensing device.

4. Provide gaskets or sealant where elements penetrate duct walls.

5. Mount sensor to allow easy removal and servicing without disturbing insulation or vapor barrier. Mount on standoff brackets to avoid condensation.

6. Coordinate the location for duct access doors downstream from each duct sensor.

K. Pipe Sensors: Provide wells for all sensors and indicators measuring temperatures in pressure vessels and piping.

1. Wells shall be stainless steel or bronze to match media requirements.

2. Verify working pressure of sensor wells.

3. Do not install wells in extension couplings.

4. Where pipe diameters are smaller than the well length, provide wells at piping elbow or tees to affect flow across the entire well area.

5. Wells may face upstream or downstream.

6. Angle wells to retain thermal fluid within the well.

7. Should wells restrict cross sectional pipe area to less than 70 percent free area, provide pipe increases at the well not less than 150 percent pipe diameter.

L. The ATC contractor shall interface with smoke detectors, smoke dampers and fire alarm devices as required to accomplish equipment shutdown, alarms, etc., as indicated in sequences.

M. For single phase motors, provide relays and/or contactors of appropriate horsepower and voltage rating as required to energize/de-energize equipment as indicated in sequences.

3.2 TEST PLAN

A. Test Plan: Prepare a written test plan indicating in a step-by-step, logical fashion, the procedures by which the automatic control system will be tested, adjusted, and checked.

B. Pre-Approval: Not less than six (6) weeks prior to testing, provide four (4) copies of the proposed test plan for approval. Meet and discuss the test plan, and make agreed changes to the written plan.

C. Content: Plan shall include, as a minimum, for each system and sub-system of the automatic control work the following:

1. System name.

2. List of devices with brief description of functional purpose of each.

3. A description of the expected signal values transmitted by the sensor.

4. A description of the expected signal values transmitted by the controller to the control device or actuator.

5. A description of the expected values of the control medium from limit-to-limit.

6. A description of the instrumentation required to test the system.

7. A description of the expected field adjustments for transmitter, controller, and control actuator should control parameters fall outside of expected values.

8. A log sheet or sheets on which expected and field read values will be recorded and final field read values indicating that the system is operating in accordance with contract requirements.

3.3 TESTS DURING AND AFTER INSTALLATION

A. Instrumentation and Control: Calibration test each controller as follows:

1. Disconnect the sensor input signal to the controller and provide a compatible test signal generator.

2. Simulate expected transmitter values and input to the controller. Record controller branch line values.

3. Examine control device and determine that the device is responding.

4. Simulate maximum and minimum transmitter signal values and verify minimum and maximum controller output values and control device minimum and maximum stroke range.

5. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedule, proportional relationship, reset relationship, and derivative reaction.

6. When the controller and control device portion of each loop are responding as designed, reconnect the sensor transmitter input line.

7. After mechanical equipment control becomes operational, perform an operational test of each control loop recording sensor, transmitter, controller input, controller output and control medium parameter.

8. Entire test shall be witnessed by an owner's representative.

9. Upon satisfactory test a copy of final test results shall be bound in the operating and maintenance manual.

3.4 FUNCTIONAL PERFORMANCE TESTING AND VERIFICATION

A. General: In addition to the tests required during and after installation of all mechanical systems, as well as any other formal commissioning requirements, the Contractor shall perform functional performance tests to verify that all systems are designed, installed, calibrated and adjusted to perform as required in the Contract.

B. Comply with all applicable specification sections including, but not be limited to, "Basic HVAC Requirements", "Testing, Adjusting and Balancing", "Automatic Temperature Controls" and "Commissioning", where applicable.

C. Prior to functional performance testing, all indicating, recording and control devices shall be calibrated. A calibration verification report shall be provided with the final test report.

D. Provide functional performance testing to verify proper operation of each and every control sequence indicated throughout the contract documents.

E. Failure of Tests: Should any test, verification, or demonstration fail to meet the specification requirements, the component of the system causing the failure shall be repaired, replaced or readjusted. The failed test, verification, or demonstration shall then be repeated.

F. A "Functional Performance Test Verification Form" is included at the end of this section. This form (electronic version is available upon request) shall be completed for all mechanical equipment provided under this contract. This shall include, but not be limited to each boiler, air handling unit, fan, pump, VRF indoor unit, DX cooling equipment, miscellaneous heating equipment, etc.

G. Test Report: Upon satisfactory verification of calibration and functional performance tests, a copy of the final test results shall be bound in the operations and maintenance manual. The final report shall also include a

full compliance statement, on company letterhead, indicating that all systems are installed and functioning per the contract requirements including drawings, specifications, control sequences and accepted submittals.

H. The mechanical systems shall not be considered complete until all functional performance verification forms, calibration reports and compliance statement have been submitted and reviewed. Submit in accordance with the submittal requirements indicated elsewhere in these specifications.

3.5 DEMONSTRATION AND TRAINING

A. Demonstration: After completion of testing as hereinbefore specified, provide demonstration and training of designated operating personnel (refer to Division-1).

1. Demonstration shall be performed.

2. Demonstration shall include the operation of the entire mechanical system under the control of the Contractor and shall include the start-up, operation, and shutdown of the system in accordance with the sequence of operation.

3. The operation of each device shall be performed in accordance with the written instructions contained in the operation and maintenance manual, a copy of which shall be available ten (10) working days prior to the test. No deviation from procedures in the operating manual will be permitted.

B. Failure to Perform: Should the system fail to perform in accordance with the requirements of the operation and maintenance manual, the system shall be repaired, recalibrated, retested as necessary, and a second demonstration performed.

1. Subsequent demonstrations shall occur until the automatic control system and all associated mechanical and electrical equipment are operating in accordance with contract requirements.

2. All testing, retesting, and recalibration shall be at no additional expense. The Contractor shall reimburse the expenses of the commissioning team for each test after the first.

3.6 INSTRUCTING OPERATING PERSONNEL

A. Instructors and Superintendent: Upon completion of the work and acceptance by the representative of the Owner, provide the services of an Instructor, who together with the superintendent specialist shall instruct designated operating personnel in the operation and maintenance of the automatic control system.

1. The services of the Instructor shall be available for not less than four 4-hour days of instruction.

2. The services of the superintendent specialist shall be available for not less than two 4-hour days.

3. Instructions shall be based upon the use of the operating and maintenance manual together with copies of the laminated control diagrams affixed adjacent to each local control panel.

4. Training and instruction will be witnessed. The witness shall monitor the entire training program and prepare a written report on the competency and effectiveness of instructors and the level of expertise of designated operators. A report will be submitted recommending additional training at additional cost, if such is deemed necessary.

3.7 BUILDING MANAGEMENT AND CONTROL SYSTEM DEVICES AND POINTS

A. Provide all building management and ATC system controllers, devices, points, etc. as required to accomplish the control sequences and equipment functions indicated throughout the contract documents, including drawings and specifications. In addition, provide all controllers, devices, points, etc. as required to control, operate, monitor and alarm all equipment and devices indicated on the contract documents (including but not limited to: boilers, pumps, air handling units, fans, variable frequency drives, VRF indoor units, valves, dampers, flow measuring devices, sensors, carbon monoxide (CO) detection devices, etc.). All points shall be available through the Energy Management Control System (EMCS). See attached points list (where applicable).

B. Building management and control points shall include status for all mechanical equipment with equipment failures alarmed at the EMCS. In addition, furnish and install all points required to provide complete, color, system graphics of all mechanical systems and components indicated throughout the contract documents. All equipment and devices indicated throughout the contract documents shall be indicated at the operator's workstation (where applicable) and all end devices shall be

individually controlled unless specifically indicated otherwise.

C. Building management and control system features for equipment and devices shall include, but not be limited to, the following where applicable: runtime, trend data, optimal start, scheduling, paging, system graphics, and internet access to graphic and text-based displays.

END OF SECTION

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FUNCTIONAL PERFORMANCE TEST VERIFICATION FORM

Project Name: _____

FUNCTIONAL VERIFICATION FOR: _____(Insert Equipment Name, i.e. Boiler, AHU, Fan, Pump, VRF Unit, etc.)

	SEQUENCE OF OPERATION	Controlling as Specified (Y/N)	ATC Technician Initials	Date	Notes
	(Insert complete sequence of operation as indicated in approved ATC submittal)				
	Example: Air Handling Unit Control				
	1. General:				
	1.1 Supply and return fans shall be interlocked. Fans shall operate continuously in the occupied mode. HOA switch shall be in the AUTO position.				
	1.2 Occupied-Unoccupied shall be as determined by the EMCS.				
	2. Temperature Control:				
	2.1 Occupied				
	A. When the outside air enthalpy is above the return air enthalpy, D-1, D-2 and D-3 shall modulate as follows:				

SECTION 23 2113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of hydronic piping work is indicated on drawings and schedules, and by requirements of this section and all other Division-23 sections.

B. Applications for hydronic piping systems include the following:

1. Heating water supply and return

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hydronic piping products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least five (5) years of successful installation experience on projects with hydronic piping work similar to that required for project.

A. Structural Performance: Pipe hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

C. Codes and Standards:

1. ASME Compliance: Fabricate and install hydronic piping in accordance with ASME B31.9 "Building Services Piping".

2. ASCE-7: Minimum Design Loads for Buildings and Other Structures.

3. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for hydronic piping, materials and products.

B. Shop Drawings: Submit scaled layout drawings as required by Division-23 Section, "Basic HVAC Requirements".

C. Record Drawings: At project closeout, submit record drawings of installed hydronic piping and piping products.

D. Maintenance Data: Submit maintenance data and parts lists for hydronic piping materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

E. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on hydronic piping systems maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in hydronic piping systems. Where more than one type of materials or products is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-23 section "Identification for HVAC Piping and Equipment".

2.3 BASIC PIPES AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings complying with Division-23 section "Pipe, Tube and Fittings for HVAC Systems", in accordance with the following listing:

B. Hydronic Piping:

1. Tube Size 2" (50 mm) and Smaller: Copper tube; Type L, hard drawn temper; wrought-copper fittings with solder-joints.

2. Pipe Size 2-1/2" (65 mm) and Larger: Black steel pipe; Schedule 40; wrought-steel buttwelding fittings with welded joints.

2.4 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Division-23 section "Piping Specialties for HVAC Systems", in accordance with the following listing:

1. Pipe escutcheons
2. Pipeline strainers
3. Dielectric fittings
4. Drip pans
5. Sleeves
6. Sleeve seals

2.5 BASIC HANGERS AND SUPPORTS

A. General: Provide hangers and supports complying with Division-23 section "Hangers and Supports for HVAC Piping and Equipment", in accordance with the following listing:

1. Adjustable steel clevises, adjustable pipe saddle supports, single pipe rolls, and adjustable roller hangers, for horizontal piping hangers and supports.
2. Two-bolt riser clamps, for vertical-piping clamps.
3. Steel turnbuckles, for hanger-rod attachments.
4. Concrete inserts, C-clamps, malleable beam clamps, and steel brackets, for building attachments.
5. Protection saddles, for saddles and shields.

2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by Kinetics Noise Control or approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.7 BASIC VALVES

A. General: Provide valves complying with Division-23 section "Valves for HVAC Piping", in accordance with the following listing:

1. Sectional Valves:

a. 2" (50 mm) and Smaller: Ball valves.

b. 2-1/2" (65 mm) and Larger: Butterfly valves.

2. Shutoff Valves:

a. 2" (50 mm) and Smaller: Ball valves.

b. 2-1/2" (65 mm) and Larger: Butterfly valves.

3. Balancing Valves:

a. Combination shut-off/balance valve with venturi type flow meter fitting with integral readout ports and memory stop.

Provide ball valve for 2" (50 mm) and smaller, butterfly valve for 2-1/2" (65 mm) and larger.

b. See Division-23 section "Hydronic Specialties" for balance valve specification.

4. Drain Valves:

a. 2" (50 mm) and Smaller: Ball valves.

5. Check Valves:

a. All sizes: Swing check valves.

2.8 BASIC EXPANSION COMPENSATION

A. General: Provide expansion compensation products complying with Division-23 section "Expansion Compensation for HVAC Piping".

2.9 BASIC METERS AND GAUGES

A. General: Provide meters and gauges complying with Division-23 section "Meters and Gauges for HVAC Piping".

2.10 BASIC VIBRATION CONTROL

A. General: Provide vibration control products complying with Division-23 section "Vibration Isolation for HVAC Piping and Equipment".

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which hydronic piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division-23 section "Identification for HVAC Piping and Equipment".

3.3 INSTALLATION OF HYDRONIC PIPING

A. General: Install hydronic piping in accordance with Division-23 section "Pipe, Tube and Fittings for HVAC Systems".

B. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.

C. Connect branch-feed piping to mains at horizontal center line of mains, connect run-out piping to branches at horizontal center line of branches.

D. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Division-23 section "Piping Specialties for HVAC Systems".

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with Division-23 section "Hangers and Supports for HVAC Piping and Equipment".

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install pipe with hangers and braces designed to support the pipe and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on pipes that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

6. Do not use powder-actuated concrete fasteners for seismic restraints.

3.7 INSTALLATION OF VALVES

A. Install valves in accordance with Division-23 section "Valves for HVAC Piping".

B. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two (2) or more hydronic terminals or equipment connections, and elsewhere as indicated.

C. Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, control valves, strainers and elsewhere as indicated.

D. Balancing Valves: Install on outlet of each hydronic terminal, and elsewhere as indicated.

E. Drain Valves: Install on each mechanical equipment item and locate to

completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic piping system.

3.8 INSTALLATION OF EXPANSION COMPENSATION PRODUCTS

A. Install expansion compensation products in accordance with Division-23 section "Expansion Compensation for HVAC Piping".

3.9 INSTALLATION OF METERS AND GAUGES

A. Install meters and gauges in accordance with Division-23 section "Meters and Gauges for HVAC Piping".

3.10 EQUIPMENT CONNECTIONS

A. General: Connect hydronic piping system to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union/flange connection on supply and return, and drain valve on drain connection.

B. Hydronic Terminals: Install hydronic terminals with hydronic terminal valve and union on inlet and outlet. Install manual air vent valve on element in accordance with manufacturer's instructions. Locate valves and balancing cocks behind valve access doors for ease of maintenance. Where indicated, install automatic temperature control valve with unions between valve and element on supply line.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Test hydronic piping in accordance with testing requirements of Division-23 section "Testing, Adjusting and Balancing."

3.12 CLEANING

A. Cleaning, Flushing, and Inspecting: Clean, flush, and inspect hydronic piping systems in accordance with requirements of Division-23 section "Pipe, Tube and Fittings for HVAC Systems".

END OF SECTION

SECTION 23 2115 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of hydronic specialties required by this section is indicated on drawings and schedules, and by requirements of this section and all other Division-23 sections.

B. Types of hydronic specialties specified in this section include the following:

1. Balancing Valves
2. Air Vents
3. Air Separators
4. Expansion Tanks
5. Pump Suction Diffusers
6. Multi-purpose Valves
7. Bypass Feeders
8. Water Relief Valves
9. Pressure Reducing Valves

1.2 QUALITY ASSURANCE

A. Hydronic Specialty Types: Provide hydronic specialties of same type by same manufacturer.

B. Codes and Standards:

1. ASME Compliance: Manufacture and install hydronic specialties in accordance with ASME B31.9 "Building Services Piping".
2. UL and NEMA Compliance: Provide electrical components of hydronic specialties which are listed and labeled by UL, and comply with NEMA standards.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of hydronic specialty. Include pressure drop curve or chart for each type and size of hydronic specialty. Submit schedule indicating manufacturer's figure number, size, location, rated capacities, and features for each required hydronic specialty.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of hydronic specialty. Include this data, product data, and shop drawings in Maintenance Manual.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following (unless otherwise noted):

1. Bell and Gossett

2. Taco

3. Amtrol

4. Flow Design, Inc.

2.2 HYDRONIC SPECIALTIES

A. General: Provide factory-fabricated hydronic specialties recommended for use in service indicated. Provide hydronic specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option, but more than one type cannot be used on project.

2.3 BALANCING VALVES

A. General:

1. Manual balancing devices shall be venturi type as defined by ASHRAE. Devices shall have a precision machined throat and have a stated catalog accuracy of 3% full scale and have an actual accuracy of ±5% of actual reading down to 10 in. w.c. pressure differential across the metering device. The induced differential reading (flow signal) shall be greater than two feet water column at the design flow with the valve in the wide open position. The permanent pressure loss at design flow shall not exceed two feet of water in the wide open position. The valves shall have differential readout ports fitted with check valve and protective cap, and are to have a memory stop to allow complete shut-off and return to set position without losing the setpoint.

B. Construction:

1. Valves 2" and Smaller: Brass ball valve, blowout proof stem, virgin Teflon seats, brass stems, stem seals and steel handles.

2. Valves 2-1/2" and Larger: Cast iron butterfly valve, full-lug type with EPDM seat, 416 stainless steel stem, bronze sleeve bearing and bronze disk. Valves 4" and smaller shall have manual lever. Valves 6" and larger shall have gear operated hand wheel.

C. Minimum Ratings:

1. Devices with sweat or NPT connections: 400 psig (2760 kPa) at 250°F (121°C).

2. Devices with flanged connections: 125 psig (862 kPa) at 250°F (121°C) suitable for the system for which it is installed.

D. Readout Meter Kit:

1. Provide a portable readout meter kit by the manufacturer of the balancing devices. The meter shall be permanently mounted in a durable case complete with two 10' (3 m) color coded hoses with shutoff valves at the end that connects to the balance valve so that water does not drain out between readings. Meter shall have a 6" (150 mm) diameter face and 1.75% full rated accuracy. Meter for the venturi type devices shall be provided with a removable transparent face indicating flow directly in GPM for each size device furnished. Meter shall have a three valve manifold for over-range protection.

E. Installation:

1. The straight pipe required to achieve 3% full scale accuracy shall be incorporated as an integral part of the venturi and valve assembly. No additional straight piping shall be required.

2. Install in accordance with the manufacturer's instructions.

3. Check connections after installation for leaks.

F. Balancing valves shall be Flow Set model UA (2" and smaller) or EF (2-1/2" and larger) as manufactured by Flow Design or equivalent.

2.4 AIR VENTS

A. Manual Air Vents: Provide manual vents designed to be operated manually with screwdriver or thumbscrew, 1/8" (3 mm) N.P.T. connection.

B. Automatic Air Vents: Provide automatic vents at all high points of the heating water system. All valves shall be cast brass, rated for 150 psig design pressure and 270°F operating temperature. Units to include non-ferrous floats, stainless steel linkage and a Viton seal which closes against a brass spring operated seat. Units shall come complete with a 20 year limited warranty against defects in materials and workmanship, which should be given to owner after installation. Automatic air vents shall be Spirotop as manufactured by Spirotherm or equivalent.

2.5 AIR SEPARATORS

A. Furnish and install a combination full flow coalescing type high efficiency air eliminator / dirt and sediment separator on the heating system.

1. Units should be selected at the point of peak efficiency per the manufacturer's recommendations.

2. Air eliminators / separators shall be fabricated steel, rated for 150 psig working pressure with entering velocities not to exceed 4 feet per second at specified GPM. Models specifically designed for high velocity systems may have an entering velocity of up to 10 feet per second.

3. Vessel diameter shall be a minimum of two times pipe size. Vessel height above the nozzle center-line shall be a minimum of 3 times pipe size for standard units and 4.5 times pipe size for high velocity units. Vessel shall extend below nozzle center-line the same distance

for dirt separation.

4. Units shall include an internal tube bundle filling the entire vessel to suppress turbulence and provide high efficiency. The bundle shall consist of a copper core tube with continuous wound copper medium permanently affixed to the core. A separate copper medium is to be wound completely around and permanently affixed to each internal element.

5. Each eliminator 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.

6. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

7. Unit shall include a blow down valve at bottom for removal of collected dirt and sediment.

8. Air eliminator function shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid during continuous circulation.

9. Dirt and sediment separator function shall be capable of removing 80% of particles 30 micron and larger within 100 passes. A properly selected strainer shall be installed upstream to collect large debris that may be left in the piping.

10. Provide removal head to facilitate internal element inspection or cleaning if required. Tube elements shall include tube sheets top and bottom and be manufactured as a bundle for ease or removal. Verify space required for bundle removal.

B. All units shall be Spirotherm or equivalent in size and construction.

2.6 EXPANSION TANKS

A. General: Provide expansion tanks of size and number as indicated. Construct tank of welded steel, constructed, tested, and stamped in accordance with Section VIII of ASME Boiler and Pressure Vessel Code (for a working pressure of 125 psi) (for a working pressure of 850 kPa). Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Provide heavy duty butyl rubber, removable bladder for inspection to separate air charge from system water, to maintain design expansion capacity. Provide pressure gage and air-charging fitting, and

drain fitting.

2.7 PUMP SUCTION DIFFUSERS

A. General: Provide pump suction diffusers as indicated. Construct unit with angle pattern cast-iron body, threaded for 2" (50 mm) and smaller, flanged for 2-1/2" (65 mm) and larger, pressure rated for 175 psi (1200 kPa). Provide inlet vanes with length 2-1/2 times pump suction diameter or greater. Provide cylinder strainer with 3/16" (5 mm) diameter openings with total free area equal to or greater than 5 times cross sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head. Provide disposal fine mesh strainer to fit over cylinder strainer. Where available, provide permanent magnet located in flow stream, removable for cleaning. Provide adjustable foot support designed to carry weight of suction piping. Provide blowdown tapping in bottom, gage tapping in side. Provide one extra mesh strainer for each pump suction diffuser.

2.8 MULTI-PURPOSE VALVES

A. General: Provide pump discharge multi-purpose valves as indicated. Provide nonslam check valve with spring-loaded disc and calibrated adjustment feature permitting regulation of pump discharge flow and shutoff. Design valves to permit repacking under full line pressure, and with bolt-on bonnet. Provide flanged cast-iron valve body, pressure rated for 175 psi (1200 kPa), maximum operating temperature of 240˚F (116˚C). Provide straight or angle pattern as indicated.

B. Multi-purpose valves shall have a pressure drop not to exceed 2 psi (14 kPa) at the scheduled pump capacity. Multi-purpose valve size shall not be more than one (1) pipe size less than full line size indicated.

2.9 BYPASS FEEDERS

A. Provide as specified in specification section 23 2500 – Water Treatment.

2.10 WATER RELIEF VALVES

A. General: Provide water relief valves as indicated, of size and capacity as selected by Installer for proper relieving capacity, in accordance with ASME Boiler and Pressure Vessel Code.

1. Combined Pressure-Temperature Relief Valves: Bronze body, test

lever, thermostat, adjustable type, complying with ANSI Z21.22 Listing Requirements for temperature discharge capacity. Provide settings to protect the equipment, piping, etc. with the lowest maximum temperature and/or pressure reading.

2. Pressure Relief Valves: Bronze body, test lever, ASME rated, adjustable type. Provide pressure relief settings to protect the equipment, piping, etc. with the lowest maximum pressure rating for each system.

2.11 PRESSURE REDUCING VALVES

A. General: Provide pressure reducing valves as required, of size and capacity as selected by Installer to maintain operating pressure on system, and as manufactured by Watts or equivalent.

B. Construction: Cast iron or brass body, low inlet pressure check valve, inlet strainer removable without system shut-down, non-corrosive valve seat and stem, factory set at operating pressure.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which hydronic specialties are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner's representative.

3.2 INSTALLATION OF HYDRONIC SPECIALTIES

A. Balancing Valves: Install venturi type balance valves at all hydronic coils and terminals including, but not limited to, heating coils, radiant floor manifolds, etc.

B. Air Vents:

1. Manual Air Vents: Install manual vents on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated. In addition, provide 1/2" ball valve with hose end connection, cap and chain at all high points within the piping system to accommodate manual venting of trapped air.

2. Automatic Air Vents: Install automatic vents at top of each hydronic riser and elsewhere as indicated. Install shutoff valve between riser and vent valve, pipe outlet to suitable plumbing drain, or as indicated.

C. In-line Air Separators: Install in-line air separators in pump suction lines. Connect inlet and outlet piping. Run piping to expansion tank with 1/4" per foot (6 mm per meter) (2%) upward slope towards tank. Install drain valve on units 2" (50 mm) and over.

D. Expansion Tanks: Install expansion tanks as indicated, in accordance with manufacturer's instructions. Vent and purge air from hydronic system, charge tank with proper air charge as recommended by manufacturer.

E. Pump Suction Diffusers: Install on pump suction inlet, adjust foot support to carry weight of suction piping. Install full size nipple and shutoff valve in blowdown connection. After cleaning and flushing hydronic piping system, but before balancing of hydronic piping system, remove disposable fine mesh strainer and install permanent strainer.

F. Bypass Feeders: Install bypass feeders on each closed hydronic system at pump discharge and elsewhere as indicated. Install in upright position with top of funnel not more than 48" (1200 mm) above floor. Pipe drain to nearest plumbing drain or as indicated.

G. Water Relief Valves: Install on hot water generators, and elsewhere as indicated. Pipe discharge to floor. Comply with ASME Boiler and Pressure Vessel Code.

H. Pressure Reducing Valves: Install for each system as required, and in accordance with manufacturer's installation instructions.

I. Multi-Purpose Valves: Provide multi-purpose valves at the discharge of each hydronic pump.

J. Low Point Drains: Provide a ball valve with hose end connection, cap and chain at all low points within the piping system to accommodate manual draining of water from the system. Drain valves shall be sized in accordance with the following criteria:

1. For pipes smaller than 3", provide 3/4" ball valve.

2. For pipes 3" – 6", provide 1" ball valve.

3. For pipes 8" and larger, provide 2" ball valve.

END OF SECTION

SECTION 23 2123 - HVAC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of pump work required by this Section is indicated on the drawings and schedules, and by requirements of this Section and all other Division-23 sections.

B. Types of pumps specified in this Section include the following:

1. In-line circulator

2. Vertical in-line

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide pumps conforming to the following standards:

1. Hydraulic Institute (HI): Manufacture pumps in accordance with "Standards for Centrifugal Rotary, and Reciprocating Pumps."

2. UL and National Electrical Manufacturers Association (NEMA): Provide electric motors and components which are listed and labeled by UL and comply with NEMA standards. All motors shall be of the premium efficiency type with NEMA enclosures suitable for application.

3. Department of Energy (DOE) compliance: Pump manufacturer shall comply with US Department of Energy (DOE) energy conservation standard for "clean water pumps" 1-200 horsepower, less than 459 feet of head and greater than 25 gpm. These pumps shall be evaluated using the Pump Energy Index (PEI) of equal to or lesser than 1.0. The PEI number shall appear on the pump name plate and be available for the record at http://er.pumps.org.

B. Certification: Provide pumps whose performances, under specified operating conditions, are certified by the manufacturer.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current pump characteristic performance curves with selection points clearly indicated.

B. Shop Drawings: Submit manufacturer's shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.

C. Manufacturer Seismic Qualification Certification: Submit certification that the hydronic pumps and accessories will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Handle pumps carefully to prevent damage, denting and scoring. Do not install damaged pumps or components; replace with new.

B. Storage: Store pumps and components in a clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work shall be limited to the following:

1. Taco

2. Bell and Gossett

3. Armstrong

2.2 IN-LINE CIRCULATORS

A. General: Provide wet rotor in-line circulators where indicated and of capacities scheduled.

B. Components:

1. The pumps shall be a wet rotor inline pump, in cast iron body construction specifically designed for quiet operation. Suitable standard operations at 230° F and 175 PSIG working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.

2. The pump internals shall be capable of being serviced without disturbing piping connections.

3. Pump shall be equipped with a water-tight seal to prevent leakage.

4. Pump volute shall be of a cast iron design for heating systems. The connection style on the cast iron and bronze pumps shall be flanged.

5. Flange to Flange dimension shall be standard booster sizes such as 6-3/8", 8-1/2", 11-1/2", and 12". Flange dimensions shall be HVAC industry standard 2 or 4 bolts sizes.

6. Motor shall be a synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will

not be acceptable.

7. Each motor shall have an Integrated Variable Frequency Drive or shall be a variable speed electronically commutated motor and tested as one unit by the manufacturer.

8. 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).

9. Pump shall have BACnet connections built into the VFD.

10. Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the VFD.

11. Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on-board thermal overload protection.

12. Pumps shall be UL 778 listed and bear the UL Listing Mark for USA and Canada with on-board thermal overload protection.

13. Each pump shall be factory performance tested before shipment.

2.3 VERTICAL IN-LINE PUMPS

A. General: Provide vertical in-line pumps where indicated, and of capacities scheduled.

B. Type: Pump shall be vertically mounted, in-line type, close coupled, single stage and designed for 175 psi (1200 kPa) working pressure.

C. Casings: Construct casings of cast iron, 125 psi (850 kPa) working pressure with ANSI flanges of equal size, and tappings for gauge and drain fittings.

D. Shafts: Provide hardened alloy steel shafts with replaceable bronze shaft sleeves.

E. Mechanical Seals: Provide an internally flushed mechanical seal assembly of a carbon rotating assembly and a silicon carbide stationary assembly or a tungsten stationary assembly and a tungsten carbide rotating assembly.

F. Shaft Sleeves: Provide removable shaft sleeves.

1. Pumps with mechanical seals, use bronze sleeves.

G. Impellers: Provide bronze impellers of the enclosed type, hydraulically and dynamically balanced, keyed to the shafts, and secured with sleeve and impeller nuts.

H. Variable Speed Operation: Pumps shall be designed for variable speed operation. Provide with grounding rings and inverter duty motors. Coordinate requirements for variable frequency drives with the electrical contractor.

PART 3 - EXECUTION

3.1 INSTALLATION OF PUMPS

A. General: Install pumps where indicated and in accordance with manufacturer's published installation instructions.

3.2 ADJUSTING AND CLEANING

A. Alignment: Check alignment and, where necessary, realign shafts of motors and pumps within the recommended tolerances of the manufacturer. For all pumps alignment shall be performed with a dial indicator.

B. Start-Up: Lubricate pumps before start-up and start-up in accordance with manufacturer's instructions.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 2300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of refrigerant piping work is indicated by requirements of this section and all other Division-23 sections.

B. Refer to requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of refrigerant piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Specialist with at least five (5) years of successful installation experience on projects with refrigerant piping work similar to that required for project.

C. Codes and Standards:

1. ASME Compliance: Fabricate and install refrigerant piping in accordance with ASME B31.5, "Refrigeration Piping", and extend applicable lower pressure limits to pressures below 15 psig (100 kPa).

2. IMC Compliance: Fabricate and install refrigerant piping in accordance with "International Mechanical Code".

3. ASHRAE Compliance: Fabricate and install refrigerant piping in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for refrigerant piping materials and products.

B. Brazing Certification: Certify brazing procedures, brazers and operators in accordance with ASME standards (ASME B31.5).

C. Shop Drawings: Submit scaled layout drawings of refrigerant pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between piping and proximate equipment.

D. Maintenance Data: Submit maintenance data and parts lists for refrigerant piping materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ASME B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigerant piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in refrigerant piping systems. Where more than one type of materials or products are indicated, selection is Installer's option. Provide refrigerant piping and accessories in accordance with equipment manufacturer recommendations.

2.2 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-23 sections "Basic HVAC Materials and Methods" and "Identification for HVAC Piping and Equipment", in accordance with the following listing:

1. Refrigerant Piping: Plastic pipe markers.

2.3 BASIC PIPES AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings complying with Division-23 sections "Basic HVAC Materials and Methods" and "Pipe, Tube and Fittings for HVAC Systems", in accordance with the following listing:

1. Tube Size 4-1/8" (105 mm) and Smaller: Copper tube; Type ACR, hard drawn temper; wrought-copper fittings; brazed joints.

2. Tube Size 1/2" (13 mm) and Smaller: Copper tube; Type ACR, soft annealed temper; wrought-copper fittings, brazed joints.

3. Brazed Joints: Braze joints using American Welding Society (AWS) classification BCuP-5 for brazing filler metal.

2.4 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Division-23 sections "Basic HVAC Materials and Methods" and "Piping Specialties for HVAC Systems", in accordance with the following listing:

1. Pipe escutcheons

2. Drip pans

3. Sleeves

4. Sleeve seals

2.5 BASIC HANGERS AND SUPPORTS

A. General: Provide hangers and supports complying with Division-23 sections "Basic HVAC Materials and Methods" and Hangers and Supports for HVAC Piping and Equipment", in accordance with the following listing:

1. Adjustable steel clevises, adjustable roller hangers, and adjustable pipe roll stands for horizontal piping hangers and supports.

2. Two-bolt riser clamps for vertical piping supports.

3. Concrete inserts, C-clamps, and steel brackets for building attachments.

4. Protection shields for insulated piping support in hangers.

5. Copper flashings for piping penetrations.

2.6 SPECIAL REFRIGERANT VALVES

A. General: Special valves required for refrigerant piping include the following types:

1. Globe and Check Valves:

a. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300°F (149°C) temperature rating, 500 psi (3450 kPa) working pressure.

b. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250°F (121°C) temperature rating, 500 psi (3450 kPa) working pressure.

2. Solenoid Valves:

a. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 Hz., UL-listed, 1/2" (13 mm) conduit adapter, 250°F (121°C) temperature rating, 400 psi (2720 kPa) working pressure.

1) Manual Operator: Provide manual operator to open valve.

3. Ball Valves:

a. Ball Valve with Access Port: Compatible with all CFC, HCFC and HFC refrigerants and oils, designed for pressures up to 775 psig, and temperature range of -40°F (-40°C) to 300°F (149°C), full port construction to match line size ID, internally equalized ball design, rupture-proof encapsulated stem, UL listed.

1) Confirm compatibility with selected VRF/equipment manufacturer.

2.7 REFRIGERANT SPECIALTIES

A. Refrigerant Strainers: Brass shell and end connections, brazed joints, monel, screen, 100 mesh, UL-listed, 350 psi (2380 kPa) working pressure.

B. Moisture-Liquid Indicators: Forged brass, single port, removable polished optical glass, solder connections, UL-listed, 200°F (93°C) temperature rating, 500 psi (3450 kPa) working pressure.

C. Refrigerant Filter-Driers: Steel shell, ceramic fired desiccant core, solder connections, UL-listed, 500 psi (3450 kPa) working pressure.

D. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi (3450 kPa) working pressure.

E. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.

F. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL-listed.

2.8 BASIC VIBRATION CONTROL

A. General: Provide vibration control products complying with Division-23 sections" Basic HVAC Materials and Methods" and "Vibration Isolation for HVAC Piping and Equipment", in accordance with the following listing:

1. Isolation hangers
2. Riser isolators
3. Riser support isolators
4. Flexible pipe connectors

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which refrigerant piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division-23 sections "Basic HVAC Materials and Methods" and "Identification for HVAC Piping and Equipment".

3.3 INSTALLATION OF REFRIGERANT PIPING

A. General: Install refrigerant piping in accordance with Division-23 sections "Basic HVAC Materials and Methods" and "Pipe, Tube and Fittings for HVAC Systems", and in compliance with equipment manufacturer's recommendations.

B. Install refrigerant piping with 1/4" per foot (6 mm per meter) (1%) downward slope in direction of oil return to compressor. Provide oil traps and double risers where indicated, and where required to provide oil return.

C. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.

D. Bleed dry nitrogen through refrigerant piping during brazing operations.

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with requirements of Division-23 sections "Basic HVAC Materials and Methods" and "Piping Specialties for HVAC Systems".

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Install supports and anchors in accordance with requirements of Division-23 sections "Basic HVAC Materials and Methods" and "Hangers and Supports for HVAC Piping and Equipment".

3.6 INSTALLATION OF SPECIAL REFRIGERANT VALVES

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions. Remove accessible internal parts before soldering or brazing, replace after joints are completed.

1. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards.

a. Wiring of solenoid valves is specified in applicable Division-26 sections, and is included as work of this section.

3.7 INSTALLATION OF REFRIGERANT ACCESSORIES

A. Refrigerant Strainers: Install in refrigerant lines as indicated, and in accessible location for service.

B. Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, in accessible location.

C. Refrigerant Filter-Dryers: Install in refrigerant lines as indicated, and in

accessible location for service.

D. Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.

E. Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or downflow portion of hot-gas lines, immediately after leaving compressor; not in riser.

3.8 EQUIPMENT CONNECTIONS

A. General: Connect refrigerant piping to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.9 FIELD QUALITY CONTROL

A. Refrigerant Piping Leak Test: Prior to initial operation, clean and test refrigerant piping in accordance with ASME B31.5, "Refrigeration Piping". Perform initial test with dry nitrogen, using soap solution to test all joints. Refrigerant piping shall be pressure tested and evacuated in accordance with the system manufacturer's recommendations, and /or as follows (whichever is more stringent):

1. Pressure Test (Air Tight Test): Pressurize the suction gas pipe, high/low pressure gas pipe and liquid pipe with dry nitrogen to a minimum pressure as per the system manufacturer. Pressure test duration shall be a minimum of 24 hours. If the pressure does not drop within the 24 hour period, the system passes. If there is a drop in pressure, check for leaks, make repairs and re-test as prescribed above.

2. Evacuation Test (Vacuum Drying): Evacuate the system from the suction gas pipe, high/low pressure gas pipe and liquid pipe to a minimum vacuum pressure as per the system manufacturer. Vacuum pressure shall be maintained in accordance with manufacturer's minimum duration recommended. If it rises, the system may either contain moisture or have leaks, if so, make repairs and re-test as prescribed above.

3. Refer to the Refrigerant Leakage Test Summary Form to document test results. No other form will be acceptable. Submit results for all systems for review.

B. Repair or replace refrigerant piping as required to eliminate leaks, and

retest as specified to demonstrate compliance.

C. Refer to Division-23 section "Testing, Adjusting and Balancing" for additional specific test criteria and test form to be completed.

3.10 DEHYDRATION AND CHARGING SYSTEM

A. Install core in filter dryer after leak test but before evacuation.

B. Evacuate refrigerant system with vacuum pump, until temperature of 35°F (2°C) is indicated on vacuum dehydration indicator.

C. During evacuation, apply heat to pockets, elbows, and low spots in piping.

D. Maintain vacuum on system for minimum of five (5) hours after closing valve between vacuum pump and system.

E. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi (14 kPa).

F. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

3.11 ADJUSTING AND CLEANING

A. Cleaning and Inspecting: Clean and inspect refrigerant piping systems in accordance with requirements of Division-23 section "Pipe, Tube and Fittings for HVAC Systems".

END OF SECTION

SECTION 23 2500 - WATER TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of water treatment is indicated by the requirements of this section.

B. Provide complete water treatment service for a period of two (2) years from date of start-up for the following systems (all systems are assumed to be in operation twelve (12) months per year):

1. Heating water systems

1.2 QUALITY ASSURANCE

A. Installer Qualifications: Work shall be performed by specialists with a minimum of five (5) years' experience on similar work to that required for project.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for water treatment materials and products.

B. Record Drawings: At project closeout, submit record drawings of installed water treatment products.

C. Maintenance Data: Submit manufacturer's maintenance data for water treatment materials and products. Include this data, product data, shop drawings and record drawings in maintenance manual.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. Furnish and install chemical feeding equipment, as specified below, to introduce chemicals into each system only when the system is operating:

1. Closed Recirculating Systems - Heating Water (Refer to Drawing E-2):

a. Five gallon (19 L) steel by-pass feeder for introducing chemicals into the hydronic system. Provide with bag filter installed across circulating pump suction and discharge lines, with tank and piping insulated using the same thickness and type of insulation as provided for the piping system. Provide funnel and valve on top for loading, drain valve in bottom, and recirculating valves on side. Construct for pressure rating of 125 psi (850 kPa).

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which water treatment materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 WATER TREATMENT SERVICES

A. Water treatment services shall be, but not limited to, the following services:

1. Analyze the available water supply for the following:

a. pH

b. Total alkalinity

c. Chlorides

d. Silica

e. Hardness

f. Total dissolved solids

2. NOTE: If alkalinity exceeds 125 PPM or hardness exceeds 300 PPM, Contractor shall furnish and install an acid feed control system. This applies to open recirculating water systems only.

3. Make service visits once per month on open systems, closed recirculating systems to adjust feeding equipment, apply chemicals, obtain and analyze samples and regulate bleed-off of open systems, in order to maintain conditions as specified below.

4. Obtain a signed work order after each visit and leave a report

indicating which systems were serviced.

5. Maintain complete records of the treatment program for each system, such records to be made available upon request.

6. Instruct mechanical contractor in field on piping and wiring of chemical feeding equipment.

7. Furnish all necessary labor, chemicals, feeding equipment, piping, wiring and instrumentation required for the specified treatment.

8. Maintain the conditions in each system as indicated in the following table:

	Heating Water Systems
pH	8.0 to 10.5
Inhibitor for Scale and Corrosion	---
(1) Cycles	---
Organic Growths	---
Corrosion Inhibitor	100 to 150 PPM (as Molybdate) or 1000 to 1500 PPM Sodium Nitrite
Sulfite	---
Chloride as C1	---
Sulfate as SO4	---
Hardness as CaCO3	---

B. Actual cycles of concentration to be determined from an analysis of the make-up water.

C. Provide corrosion inhibitor as indicated.

1. Closed recirculating systems shall be filled and sufficient detergent and dispersant added to remove all dirt, oil and grease. System shall

be circulated for at least forty-eight (48) hours after which a drain valve at the lowest point shall be opened and allowed to bleed while the system continues to circulate. The automatic make-up valve shall be checked to make sure it is operating. Bleeding shall continue until water runs clear and all detergent is removed. A sample of water shall be tested and if pH exceeds the pH of the make-up water, draining shall be resumed.

a. Prior to adding cleaning chemical to the closed system, all radiant floor manifolds should be isolated by closing the inlet and outlet valves and opening the by-pass valves. This is done to prevent dirt and solids from lodging in the coils.

b. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each manifold, close the by-pass valves and clean all strainers.

2. New boilers shall be boiled out with an alkaline type boiling out compound to remove grease, oil, millscale and other foreign matter. The compound should be used at the rate of 1-1/2 pounds per 20 boiler horsepower (.7 Kg per 15 kW boiler horsepower). After the boiling out period, the boiler shall be completely drained, flushed and refilled with fresh water.

3. After final testing for leaks, all new potable water lines shall be thoroughly flushed by plumbing contractor to remove foreign material. Before placing the systems in service, Contractor shall engage a qualified service organization, to sterilize the systems in accordance with the following procedure:

a. Through a 3/4" (20 mm) hose connection in the main entering the building, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 PPM. Plumbing contractor shall provide plumbing connections and power for pumping chlorine into the system.

b. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.

c. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 PPM chlorine, retain this water in the system for three hours.

d. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system.

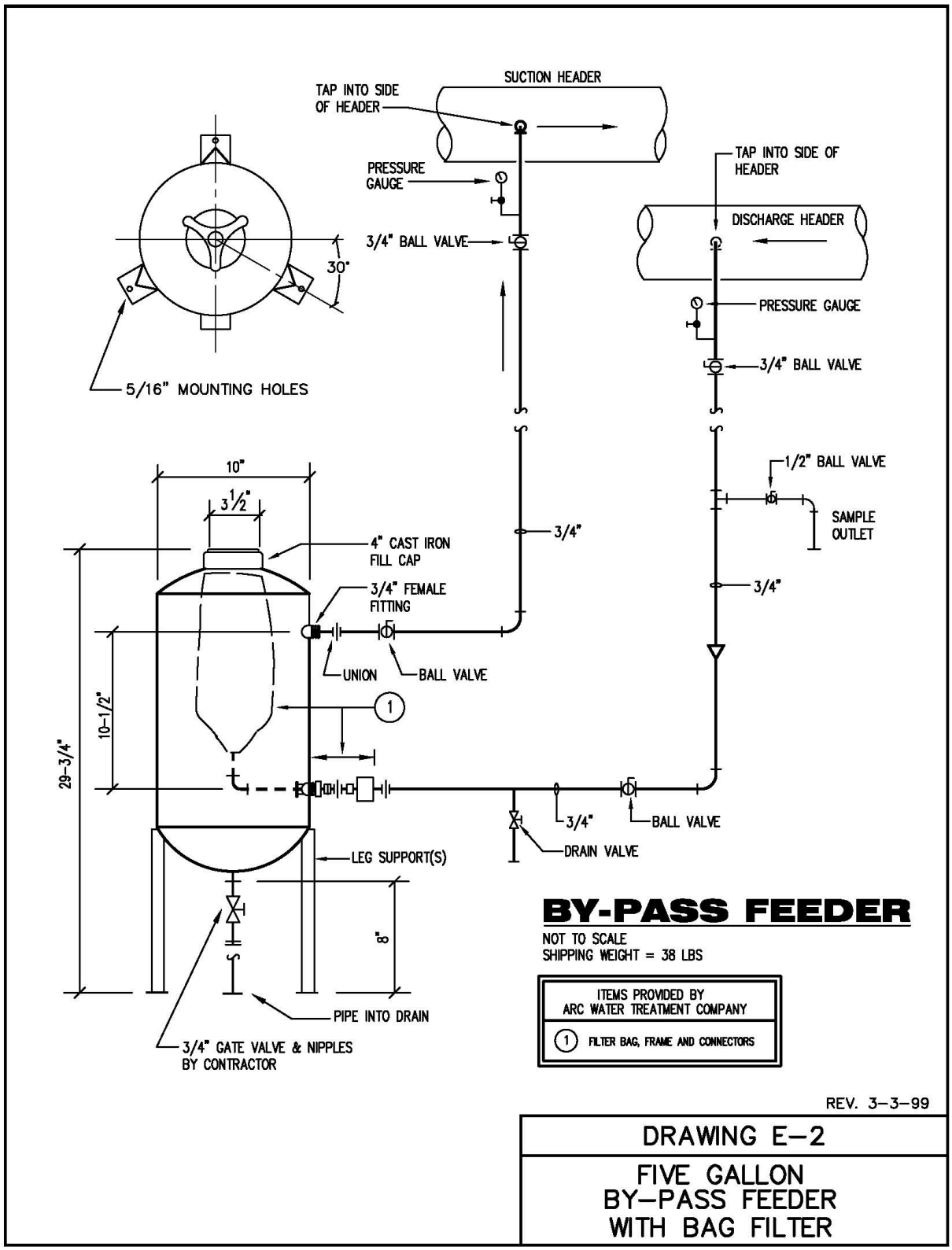
e. At the end of the retention period, no less than 100 PPM of chlorine shall be present at the extreme end of the system.

f. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 PPM.

g. Obtain representative water samples from the system for analysis by a recognized bacteriological laboratory.

h. If the sample tested for coliform organisms is negative, a letter and laboratory reports shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization.

i. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.


SUCTION HEADER
TAP INTO SIDE OF HEADER
PRESSURE GAUGE
3/4" BALL VALVE
30°
5/16" MOUNTING HOLES
TAP INTO SIDE OF HEADER
DISCHARGE HEADER
PRESSURE GAUGE
3/4" BALL VALVE
1/2" BALL VALVE
SAMPLE OUTLET
3/4"
3/4"
10"
3 1/2"
4" CAST IRON FILL CAP
3/4" FEMALE FITTING
UNION
BALL VALVE
1
10-1/2"
29-3/4"
3/4"
BALL VALVE
DRAIN VALVE
LEG SUPPORT(S)
8"
PIPE INTO DRAIN
3/4" GATE VALVE & NIPPLES BY CONTRACTOR
BY-PASS FEEDER
NOT TO SCALE
SHIPPING WEIGHT = 38 LBS
ITEMS PROVIDED BY ARC WATER TREATMENT COMPANY
1 FILTER BAG, FRAME AND CONNECTORS
REV. 3-3-99
DRAWING E-2
FIVE GALLON BY-PASS FEEDER WITH BAG FILTER

END OF SECTION

SECTION 23 3113 - LOW PRESSURE DUCTWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of low pressure ductwork is indicated on drawings and in schedules, and by requirements of this section and all other Division-23 sections. Low pressure duct systems shall be defined as those duct systems which have an external static pressure (E.S.P.) of less than two-inches (2") water gauge (wg) (500 Pa). See schedules on drawings for external static pressure information.

B. Types of low pressure ductwork which may be required for this project include the following:

1. Return air ductwork
2. Outdoor air ductwork (conditioned or unconditioned)
3. Exhaust ductwork
4. Relief ductwork
5. Kitchen exhaust ductwork
6. Supply air ductwork (downstream of air terminal units or systems without air terminal units)
7. Air transfer ductwork
8. Seismic-restraint devices

C. Pressure Classification:

1. All ductwork provided under this section shall be "Duct Pressure Class 2" as defined by SMACNA Standards.

1.2 QUALITY ASSURANCE

A. Installer: A firm with a minimum of five (5) years of successful installation experience on projects with low pressure ductwork systems similar to that required for project.

B. SMACNA Standards: Comply with latest edition of SMACNA Standards for fabrication, storage and installation of low pressure ductwork. In addition, all new ductwork shall comply with SMACNA's "Duct Cleanliness for New Construction Guidelines." The "Duct Cleanliness Level" for all ductwork shall meet the requirements of the "Advanced Level."

C. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

D. ASHRAE Standards: Comply with ASHRAE Standards for fabrication and installation of low pressure ductwork.

E. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems."

F. Field Reference Manual: Have available at project field office, copy of SMACNA Standards - latest edition.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications on manufactured products used for work of this section.

B. Shop Drawings: Submit dimensioned layouts of ductwork showing both the accurately scaled ductwork and its relation to space enclosure as required by Division-23 Section, "Basic HVAC Requirements". Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed ductwork, duct accessories, and outlets and inlets.

D. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect shop-fabricated ductwork, accessories and purchased products

from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. All ductwork shall be shipped to the site with covered ends. The ductwork shall be covered with 3-mil (minimum) shrink wrap, with a minimum 2-inch overlap on all sides, to provide a water-tight seal at each opening. The covered ends shall remain intact until installation.

C. Store ductwork, accessories and purchased products inside and protect from weather.

D. Ductwork fittings and accessories stored on site for installation shall be covered with protective tarps and elevated a minimum of four inches until installed.

E. Provide periodic (weekly) photographs of the jobsite storage to document that the ductwork is stored in accordance with the criteria outlined in this specification section.

F. Lined ductwork not stored in accordance with the above criteria shall be replaced in its entirety. Unlined ductwork not stored in accordance with the above criteria shall be cleaned and inspected by the Owner's representative prior to installation. Contractor shall clean unlined ductwork to the satisfaction of the Owner, or replace at the Owner's discretion.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting. Provide interior lining or double wall duct as indicated on the drawings and/or these specifications.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI/ASTM A 527, lockforming quality, with ANSI/ASTM A 525, G90 zinc coating.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes

indicated. Provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Liner: Minimum one inch (25 mm) thick (unless otherwise noted) fiberglass, minimum R-value of 4.2 (k-value 0.24 or better), complying with ASTM C 1071, ASTM G 21, ASTM G 22, NFPA 90A, NFPA 90B and UL 181. Duct lining shall contain an EPA registered antimicrobial agent which resists the growth of bacteria and fungi as proven by tests in accordance with ASTM G21 and G22. Liner noise reduction coefficient (NRC) shall be 0.70 or better. Surface of liner shall have water repellent properties. Duct liner shall be Johns Manville Linacoustic RC or equivalent by Certainteed, Knauf or Owens Corning.

C. Duct Liner Adhesive: Comply with Adhesive and Sealant Council, Inc. (ASC) and ASTM C916.

D. Duct Liner Fasteners: Comply with SMACNA Standards. Fasteners shall not compress liner by more than 1/8".

E. Duct Sealant: Non-hardening, non-migrating, oil based mastic or liquid elastic sealant (type applicable for fabrication and installation) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant shall be solvent (oil) based as follows:

1. Solvent (oil) based sealant shall be used for indoor applications on all new construction installations. In addition, for indoor renovation projects, solvent (oil) based sealant shall be included in the contractor's bid and utilized wherever the sealant odor is not objectionable to the owner. Contractor shall coordinate with the owner's representative prior to the duct installation.

2. Maximum duct leakage requirements outlined in these Division-23 specifications shall be maintained.

F. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

G. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. Except where space is indicated as "High Humidity" area, interior support materials of not less than 1/4" (6 mm) diameter or 3/16" (4.8 mm) thickness may be plain (not galvanized).

2.3 FABRICATION

A. Shop fabricate ductwork in 4 (1200 mm), 8 (2400 mm), 10 (3000 mm) or 12-foot (3600 mm) lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop fabricate ductwork of gauges and reinforcement complying with SMACNA Standards - latest edition.

C. Shop fabricate ductwork of gauges and reinforcement complying with ASHRAE Standards.

D. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to one and one-half times the associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

E. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements.

F. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

G. Low pressure rectangular ductwork, fittings, etc., shall be constructed, installed and supported in accordance with current SMACNA Standards of gauges not less than the following:

Maximum Side	Minimum Gauge
Up to 12" (Up to 300 mm)	26 (.5 mm)
13" to 30" (325 mm to 750 mm)	24 (.7 mm)
31" to 60" (775 mm to 1500 mm)	22 (.8 mm)
61" to 84" (1525 mm to 2100 mm)	20 (1.0 mm)

H. All factory or shop fabricated ductwork shall be constructed as required to meet the testing requirements indicated in this section and Division-23 section "Testing, Adjusting and Balancing."

2.4 SPIRAL DUCTWORK

A. Spiral duct shall have locked seams equivalent to United McGill "Uni-Seal," so made as to eliminate any leakage under the pressures for which this system has been designed. Spiral duct shall be manufactured of galvanized steel meeting ASTM A-527 by the spiral lockseam method and in the minimum gauges listed:

Diameter	Minimum Gauge
3" thru 26" (75 mm thru 650 mm)	26 (.5 mm)
28" thru 36" (700 mm thru 900 mm)	24 (.7 mm)

1. All fittings are to have continuous welds along all seams. All divided flow fittings are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections. Fittings and couplings shall be of the following minimum gauges:

Diameter	Minimum Gauge
3" thru 26" (75 mm thru 650 mm)	24 (.7 mm)
28" thru 36" (675 mm thru 900 mm)	22 (1.0 mm)

2. Branch fittings supplying linear bar diffusers shall be "lo-loss" conical type saddle taps.

3. All 90 degree tees and 45 degree laterals, either full size or reducing, shall be conical pattern for 90 degree and straight pattern for 45 degree laterals, produced by machine or press forming. The entrance shall be free of weld build-up, burrs or irregularities. Provide tangential tees where required.

4. Elbows in diameters 3" (75 mm) through 12" (300 mm) shall be two section die-stamped elbows. All other elbows shall be gored construction with all seams continuous-welded. Elbows shall be fabricated to a centerline radius of 1.5 times the cross section diameter. All elbows not die-stamped shall be fabricated according to the following schedule:

Elbow Angle	Number of Gores
Less than 45˚	2
46˚ thru 60˚	2
Over 61˚	3

5. The reduction of divided flow fittings shall be conical spun section in the thirty-six reductions in sizes 4" (100 mm) through 22" (550 mm).

6. Spun bellmouth connections shall be used at each round take-off from the high pressure plenum.

7. Offset fittings shall be constructed so that length of offset is not less than two (2) duct diameters.

8. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint, minimum two (2) coats.

9. Supports and sealants shall conform to applicable portions of SMACNA.

10. Flexible ductwork shall be as previously specified for low pressure duct systems.

2.5 FLEXIBLE DUCTWORK

A. General: Provide insulated flexible ductwork where indicated on drawings, as manufactured by Flex Master Type 6B, or equivalent. Flexible ductwork shall be in compliance with UL-181 Class 1 Air Duct, fabricated with an acoustically transparent nylon inner fabric.

1. Liner: Nylon fabric, mechanically locked without adhesives.

2. Helix: Corrosion resistant galvanized steel; formed and mechanically locked to fabric.

3. Vapor Barrier: Black fire retardant, polyethylene.

4. Insulation: 1" thick. R-value of 6.0.

5. Pressure Rating: 6" wg positive.

Sound Attenuation: Flexible ductwork shall have minimum sound attenuating capabilities as indicated below for nominal three feet of straight duct:

Duct Diameter	Insertion Loss (db)					
	125 (2)	250 (3)	500 (4)	1000 (5)	2000 (6)	4000 (7)
6	9	10	11	12	12	12
8	9	9	10	10	12	12
10	9	9	9	10	11	10

12 9 8 8 9 11 8

2.6 KITCHEN EXHAUST DUCTS

A. General: Fabricate kitchen exhaust ducts and supports, used for smoke and vapor removal from cooking operations, of 16 gauge (1.6 mm) minimum carbon steel where concealed, and of 18 gauge (1.3 mm) minimum stainless steel where exposed. For duct construction, comply with SMACNA "Low Pressure Duct Standards - Latest Edition", and ANSI/NFPA 96 "Ventilation Control and Fire Protection of Commercial Cooking Operations."

2.7 FRESH AIR INTAKE PLENUMS

A. Fresh air intake plenums shall be double wall construction (minimum 18 gauge exterior wall, 20 gauge interior wall) with 2" (50 mm) thick, three pound density insulation.

2.8 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by Kinetics Noise Control or approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK

A. General: Assemble, install, support and seal ductwork in accordance with recognized industry practices which will achieve air tight (not to exceed 1% leakage) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8" (3 mm) mis-alignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.

B. Seal ductwork to SMACNA Standard Seal Class "A" and provide additional sealant as required to meet duct test requirements of this section.

C. Install concrete inserts as required, for support of ductwork in coordination with formwork, as required to avoid delays in work.

D. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

E. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" (13 mm) where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" (25 mm) clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

F. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and their electrical equipment spaces and enclosures.

G. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gauge as duct. Overlap opening on four (4) sides by at least 1-1/2" (40 mm).

H. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

I. Support ductwork in manner complying with SMACNA Standards - latest edition of hangers and supports section.

J. Where vapors will be exhausted (dishwasher, cart wash, tunnel wash, canopy hood over sterilizers, etc.), ductwork shall be sloped back toward the source of moisture.

K. All exposed ductwork (in non-mechanical rooms) shall be primed and painted with paint appropriate for sheet metal surfaces. See architectural section "Painting".

L. Provide gasketed duct access doors as required to provide maintainable access to the upstream side of coils, humidifiers, etc.

3.2 INSTALLATION OF LINED DUCTWORK

A. Provide lined ductwork at the following locations, and as otherwise indicated:

1. All ductwork (supply, return, conditioned outside air, DOAS/ERU exhaust return) within the Mechanical Room.

2. All ductwork within 25 feet upstream and downstream of air handling equipment (in all directions, including all duct branches and mains within 25 feet of equipment), including return air fans, with the exception of unconditioned outdoor air intake ductwork.

3. Supply air ductwork downstream of air terminals.

4. All air transfer ductwork, unless otherwise indicated.

B. Dimensions on drawings indicate inside clear dimensions.

C. Fiberglass liner exposed to the air stream shall not be utilized for outdoor air intake ductwork.

D. Where ductwork is exposed to view in occupied areas, rectangular ductwork shall be lined and round ductwork shall be double wall duct

with internal lining, unless otherwise noted.

3.3 INSTALLATION OF FLEXIBLE DUCTWORK

A. Where indicated, provide factory insulated flexible ductwork between low pressure supply ductwork and round inlet ceiling diffusers. Provide side take-off fitting with damper (Flexmaster USA, model STOD or equivalent) between the flexible duct and the low pressure supply ductwork. Extend rigid sheet metal ductwork between the fitting and the flexible ductwork as required. The maximum length of flexible duct shall be 3'- 0" (915 mm).

B. Connections to round neck diffusers shall include a rigid 45 degree sheet metal elbow at the diffuser inlet.

3.4 INSTALLATION OF KITCHEN EXHAUST DUCTS

A. General: Fabricate joints and seams with continuous welds for watertight construction. Provide for thermal expansion of ductwork through 2000˚F (1093˚C) temperature range. Install without dips or traps which may collect residues, except where traps have continuous or automatic residue removal. Provide access openings at each change in direction, located on sides of duct 1-1/2" (40 mm) minimum from bottom, and fitted with greasetight covers of same material as duct. Installation of ductwork and associated fan(s) shall comply with NFPA 96 "Ventilation Control and Fire Protection of Commercial Cooking Operations," including duct clearances from combustible/non-combustible building materials.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

6. Do not use powder-actuated concrete fasteners for seismic restraints.

3.6 CLEANING AND PROTECTION

A. Prior to installation, thoroughly clean ductwork internally of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, install sheet metal temporary closures which will prevent entrance of dust and debris until the time all connections are to be completed.

C. Provide MERV 13 filter media at all return air inlet locations throughout the

duration of construction. Filter media shall not be removed until final filters are installed in the air handling units.

3.7 DUCT TESTING

A. Prior to the balancing of systems by the AABC certified balancing contractor, all low pressure ductwork shall be tested by the mechanical contractor for duct leakage. Duct leakage shall not exceed 1%. In addition, current SMACNA and AABC Standards shall apply, where applicable, to meet the maximum 1% leakage. Duct leakage shall not exceed 1% of design cfm for a duration of ten (10) minutes. Test pressures shall be not less than the following:

1. Ductwork systems less than 2.0 in. wg E.S.P.: Test to 2 in. wg

B. Insulation materials shall not be applied until systems have been witnessed, documented, and submitted to meet the above testing requirements.

C. The balance contractor shall witness and certify all duct pressure tests.

D. Contractor shall submit duct leakage test results to the A/E within 72 hours of completed tests. Only test results that meet the specified leakage requirements shall be submitted. Duct test results shall be recorded on the "Air Duct Leakage Test Summary Form" located at the end of Section 230593; no other forms will be accepted. In addition, the duct leakage submittals shall include 11x17 drawing(s) as required to clearly indicate the full extent of the duct test section (each duct test section shall be numbered and color coded).

E. All duct leakage test results shall be included with the final TAB report and the O&M Manual. The orifice tube calibration chart shall also be included with the final duct leakage test report information.

3.8 BALANCING

A. Refer to Division-23 section "Testing, Adjusting and Balancing" for air distribution balancing of low pressure ductwork; not work of this section.

END OF SECTION

SECTION 23 3300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section and all other Division-23 sections.

B. Types of ductwork accessories required for project include the following:

1. Dampers:
    a. Low pressure manual dampers
    b. Control dampers
    c. Counterbalanced dampers
2. Smoke dampers
3. Turning vanes
4. Duct hardware
5. Duct access doors
6. Flexible connections
7. Penetration seals
8. Sound attenuators
9. Seismic-restraint devices

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of latest edition of SMACNA Standards. In addition, all duct accessories shall comply with SMACNA's "Duct Cleanliness for New Construction Guidelines." The "Duct Cleanliness Level" for all ductwork shall meet

the requirements of the "Advanced Level."

2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

3. UL Compliance: Construct, test, and label smoke dampers in accordance with UL Standards 555 and 555S.

4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. Refer to structural drawings for seismic design criteria.

C. Duct Cleaning Contractor:

1. Duct cleaning contractor shall have been regularly engaged in commercial type duct cleaning services for a minimum of five (5) years of successful operation.

2. NADCA Certified: The duct cleaning contractor shall be certified by the National Air Duct Cleaners Association (NADCA).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, materials of construction and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual.

D. Duct cleaning contractor shall submit proposed approach, methodology and detailed cleaning and sanitizing process for each system listed above for approval prior to work being performed. In addition, provide

documentation of NADCA certification, as well as five (5) years of successful performance.

E. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

PART 2 - PRODUCTS

2.1 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with the latest edition of SMACNA Standards. Provide damper extender rods as required to compensate for external duct insulation.

B. Control Dampers: Refer to Division-23 section "Automatic Control Systems" for control dampers; not work of this section.

C. Counterbalanced Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at indicated static pressure. Construct blades of 16-gauge (1.6 mm) aluminum. Provide 1/2" (13 mm) diameter ball bearings, 1/2" (13 mm) diameter steel axles spaced on 9" (230 mm) centers. Construct frame of 2" x 1/2" x 1/8" ((50 mm x 13 mm x 3 mm) steel channel for face areas 25 sq. ft. (2.3 m^2) and under; 4" x 1-1/4" x 16-gauge (100 mm x 30 mm x 1.6 mm) channel for face areas over 25 sq. ft. (2.3 m^2). Provide galvanized steel finish on frame with aluminum touch-up.

2.2 SMOKE DAMPERS

A. Motor Driven Smoke Dampers: Provide motor driven smoke dampers in types and sizes indicated and where required by NFPA and local authorities as indicated on the drawings. Dampers shall be multi-blade type with frames and blades constructed of galvanized steel. Dampers shall be UL 555 and 555S listed with Class I leakage characteristics at 250°F (8 CFM/ft^2 at 4" WG). Dampers located in medium pressure systems shall have air foil blades. Dampers in low pressure systems are to be standard "V" groove type. Dampers shall have factory sleeves meeting the requirements of UL. Electric actuators shall be provided by the damper manufacturer and installed at the factory externally on the damper sleeve. Actuators shall be UL approved as an assembly with the damper. Provide end position indicator switches for use by ATC. Duct type smoke detectors shall be furnished under Division-28.

1. Coordinate the damper voltage with the smoke/duct detector relay voltage.

2. See drawings for additional information regarding wiring of smoke and smoke dampers.

B. Dampers shall be as manufactured by Ruskin, Greenheck, Nailor, Air Balance, Pottorff, or United Enertech, subject to compliance with requirements indicated.

2.3 TURNING VANES

A. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" (40 mm) wide curved blades set at 3/4" o.c. (20 mm), supported with bars perpendicular to blades set at 2" o.c. (50 mm), and set into side strips suitable for mounting in ductwork.

2.4 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide duct test holes in ductwork at fan inlet and outlet, and elsewhere as indicated, consisting of slot and cover, for instrument tests.

2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12" (300 mm). Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.5 DUCT ACCESS DOORS

A. General: Provide duct access doors where required for duct accessory access. Provide access doors for smoke dampers and smoke detectors. Install access doors upstream of duct type smoke detectors.

B. Construction: Construct of same or greater gage as ductwork served and provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork and extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" (300 mm) high and smaller, 2 handle-type latches for larger doors.

2.6 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flame retardant fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.7 PENETRATION SEALS

A. Provide seals for all openings through fire-rated walls, floors or ceilings used as passage for mechanical components such as ductwork. See Division-23 section "Basic HVAC Materials and Methods" for penetration seals and firestopping requirements.

B. Provide seals for all openings through walls, floors or ceilings used as passage for mechanical components such as ductwork.

2.8 SOUND ATTENUATORS (SILENCERS)

A. General:

1. Sound attenuator manufacturer shall provide testing in accordance with ASTM E-477-2013.

2. Sound attenuator inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at sound attenuators are not permitted unless shown on the contract drawings.

B. Materials:

1. General:

a. Rectangular Attenuators: All rectangular attenuators shall be constructed with a 22 gauge galvanized steel outer casing and 26 gauge galvanized perforated steel inner wall.

b. Elbow Attenuators: All elbow attenuators shall be constructed with an 18 gauge galvanized steel outer casing and 22 gauge galvanized perforated steel inner wall. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as

necessary to achieve the scheduled insertion loss. All elbow attenuators with a turning cross-section dimension greater than 48" shall have at least two half splitters and one full splitter.

c. Circular Attenuators: All circular attenuators shall be constructed based on the following constraints:

1) Silencers with a diameter less than 18 inches shall be constructed of no less than 22 gauge casing and 26 gauge perforated metal.

2) Silencers with a diameter between 18 inches and 30 inches shall be constructed of no less than 20 gauge casing and 26 gauge perforated metal.

3) Silencers with a diameter between 30 inches and 54 inches shall be constructed of no less than 18 gauge casing and 22 gauge perforated metal.

4) Silencers with a diameter greater than 54 inches shall be constructed of no less than 18 gauge casing and 22 gauge perforated metal.

d. Access Doors: Where required, attenuators shall be supplied with an access door(s) to permit smoke damper service. Access doors shall be supplied as an integral part of the attenuator by the attenuator manufacturer.

2. Dissipative Silencers:

a. Acoustic Media: Media shall be treated with an EPA registered non-toxic anti-microbial agent to protect against mold, mildew, bacteria and fungi. The media shall not contain formaldehydes, phenolic resins or volatile organic compounds (VOC's). The media shall comply with UL 181 and NFPA 90A.

b. Combustion Ratings: Attenuator materials, including glass fiber shall have maximum combustion ratings as noted below when tested in accordance with ASTM E84, NFPA 255 or UL 723.

Flame Spread Index: 10
Smoke Developed Index: 50

3. Film Lined Silencers:

a. The acoustic media shall be completely wrapped with Vibar™ film to help prevent shedding, erosion and impregnation.

b. Combustion Ratings: Attenuator materials, including glass fiber shall have maximum combustion ratings as noted below when tested in accordance with ASTM E84, NFPA 255 or UL 723.

Flame Spread Index: 25
Smoke Developed Index: 50

4. No-Media Silencers:

a. No-Media silencers shall not contain absorptive media of any kind. Attenuation shall be achieved with controlled impedance membranes and broadly tuned resonators.

C. Construction:

1. Sound attenuators shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed.

2. Material gauges noted in Paragraph B, are minimums.

3. Material gauges shall be increased as required for the system pressure and velocity classification. The attenuators shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.

4. Where required, silencer shall be constructed from stainless steel or aluminum.

5. Casings shall be lockformed and sealed, except as noted in Paragraph B, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.

6. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.

D. Acoustic Performance:

1. Sound attenuator dynamic insertion loss shall not be less than that listed in the attenuator schedule.

2. Sound attenuator generated noise shall not be greater than that listed in the attenuator schedule.

3. Acoustic performance shall include dynamic insertion loss and generated noise for forward flow (air and noise in same direction) or

reverse flow (air and noise in opposite direction) in accordance with the project's air distribution system requirements.

4. All attenuator ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test attenuator in accordance with the ASTM E-477-06a test standard. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.

E. Aerodynamic Performance:

1. Attenuator pressure drops shall not exceed those listed in the attenuator schedule. Attenuator pressure drop measurements shall be made in accordance with the ASTM E-477-06a test standard. Tests shall be conducted and reported on the identical units for which acoustical data is presented.

F. Submittals:

1. Provide acoustical system calculations for all duct systems with attenuators to demonstrate that the resultant ductborne sound levels of the equipment as measured in the occupied spaces meet the specified criteria. In the absence of specified background sound level criteria, the guidelines as expressed in Table 34 of Chapter 47, "Sound and Vibration Control" of the 2003 ASHRAE Handbook - HVAC Applications, shall be used.

2. The manufacturer shall supply certified test data for each scheduled attenuator. The data shall include dynamic insertion loss, generated noise and pressure drop for forward or reverse flow, matching the project's air distribution system requirement. All ratings shall be conducted in the same facility and shall utilize the same attenuator.

G. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work shall be limited to Vibro-Acoustics or Semco.

2.9 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by Kinetics Noise Control or approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Provide smoke dampers where ducts penetrate a smoke partition, and elsewhere as indicated.

C. Install balancing dampers where indicated, and at each ducted air inlet and outlet. Dampers are not required where a single air outlet occurs downstream of an air terminal (VAVs, fan powered boxes, etc.).

D. Install turning vanes in square or rectangular elbows (45 degrees and

greater) in supply, return and exhaust air systems, and elsewhere as indicated.

E. Install airtight access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter. Duct access panels shall be adequately sized to provide access to all smoke damper smoke detectors.

F. All electrical connections to smoke damper actuators and smoke detectors (duct or ceiling mounted) shall be provided by the ATC contractor.

G. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.
6. Do not use powder-actuated concrete fasteners for seismic restraints.

3.4 DUCT CLEANING

A. Prior to cleaning or sanitizing ductwork/equipment, all equipment utilized to perform those processes shall be sanitized. Examine ductwork/equipment prior to performing work and provide new duct openings where required to provide visual inspection of the duct interior.

B. Unless indicated otherwise, the systems shall be cleaned and sanitized in the following order:

1. Exhaust systems

2. Return systems

3. Air handling unit(s)

4. Air handling unit supply systems

C. Duct cleaning of the above systems listed shall include air devices etc.

D. Cleaning Process:

1. General:

a. Systems shall be de-energized while duct cleaning and sanitizing are in progress.

b. HEPA filter vacuums shall be used to keep room air clean. Ceiling tile shall be handled with care, and repaired or replaced as required to restore to the original condition.

2. Air Handler Cleaning Procedures:

   a. Vacuum completely, beginning with the area upstream of the filters. Filters shall be replaced at the completion of the work.

   b. Vacuum the fan and fan chamber.

   c. Wash/degrease fan blades as required.

   d. Wash/degrease chamber upstream of the coils as required.

   e. Clean coils.

   f. Sanitize.

3. Coil Cleaning Procedure: The procedure shall be customized to the situation encountered. The most heavily soiled coils may take a more complicated procedure of solution/pressure spraying. Most require only low pressure application of special cleaning solution and rinsing after they are first fully vacuumed.

4. Furniture Coverage from Incidental Dirt: As required, drape surrounding instruments, computers and areas with plastic to protect them from any incidental dirt generated during the cleaning process. Work environment shall be clean at all times. Floor shall be vacuumed as needed.

5. Duct Cleaning: Cleaning shall be accomplished by mechanical means in conjunction with the use of High CFM HEPA style vacuums and three (3) filtered canister vacuums. Mechanical means may include vacuum brushing of the duct interior, auger style mechanical devices, or high pressure air activated in duct cleaning devices to scrape off any dirt adhered to duct walls. Cleaning may be accomplished by a combination of these methods. Where possible, clean a full run or section before beginning another to insure full cleaning coverage. All material in the vacuum shall be disposed of daily after being treated with a sanitizer.

6. Sanitizing Process: Sanitizing shall be accomplished in two stages. First, it shall be done as each section of the air system is cleaned. The sanitization process shall be repeated again after the complete system has been cleaned. All sanitizing shall be completed before access is sealed. Diffusers shall be cleaned and sanitized. EPA

recognized/registered sanitizers only shall be used. MSDS information shall be supplied for materials selected. Sanitizers/encapsulants shall not be used as a substitute for proper cleaning.

7. Clean Tests: Tests for bacteria/fungi shall be performed after all cleaning and sanitizing is completed to insure the clean standards have been met. This shall be done while the system is in operation and shall be a minimum of forty-eight (48) hours after the last sanitation has been completed.

8. Closing and Sealing: Provide galvanized sheet metal plate(s) to be used as access for the majority of locations. Square cut 22 gauge metal shall be used with each plate to lap its edges by one inch all around. Screws shall be placed at four inch (100 mm) intervals and the plate shall be sealed with a water-based fireproof sealant to ensure proper seal of the system to match existing pressure classification.

9. Encapsulation: There may be times when it is necessary to use an encapsulant on interior lined duct. It should be used only if circumstances require it (for example, the lining may be breaking down), and shall be agreed to in advance by the client. It shall not be used as a substitute for cleaning.

10. Duct cleaning shall be performed by Applied Building Technologies, Inc. or equivalent.

3.5 FIELD QUALITY CONTROL

A. Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings and adjust for proper operation.

1. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting and Balancing."

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Provide MERV 13 filter media at all return air inlet locations throughout the duration of construction. Filter media shall not be removed until final filters are installed in the air handling units.

3.7 EXTRA STOCK

A. Furnish extra fusible links to the Owner; one (1) link for every ten (10) installed of each temperature range.

END OF SECTION

SECTION 23 3400 - FANS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of fan work required by this section is indicated on drawings and schedules, and by requirements of this section and all other Division 23 sections.

B. Types of fans required for project include the following:

1. Inline Centrifugal Fans
2. Base Mounted Centrifugal Fans
3. Sidewall Propeller Fans

C. Refer to the requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. AMCA Compliance: Provide fans bearing the AMCA Certified Ratings Seal. Sound rate fans in accordance with AMCA 300 "Test Code for Sound Rating Air Moving Devices".
2. ASHRAE Compliance: Test and rate fans in accordance with ASHRAE 51 (AMCA 210) "Laboratory Methods of Testing Fans for Rating".
3. UL Compliance: Provide fans electrical components which have been listed and labeled by UL.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for fans, including specifications, capacity ratings, fan performance curves with operating point clearly indicated, gages and finishes of materials, dimensions, weights, accessories furnished, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing fan dimensions, required clearances, construction details, and field

connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to fan units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

E. Manufacturer Seismic Qualification Certification: Submit certification that the destratification, exhaust fans, and components will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

    b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fans manufacturer.

C. Store fans in clean dry place and protect from weather and construction traffic.

D. Comply with manufacturer's rigging and installation instructions for fans, and moving them to final location.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

A. General: Provide centrifugal fans of sizes and arrangement as indicated, and of capacities and having accessories as scheduled.

B. Fans shall be backward inclined flat-bladed non-overloading fans. Fans with wheel diameter of 18-1/4" (463 mm) and larger shall be airfoil type, unless otherwise designated on plans.

C. Wheel diameters shall be in accordance with the standard sizes adopted by AMCA for non-overloading fans. Blades shall be welded to backplate and to spun inlet cone. Inlets shall be fully streamlined and housing shall be suitable braced to prevent vibration or pulsation.

D. Bearings shall be "Air Handling Quality Bearings" with an L10-200,000 hour rating based on the maximum speed range of the fan's AMCA class. Class III fans with bearings larger than 2-3/16" (55 mm) shall have double-row spherical split-housed bearings. All bearings shall be equipped with regreasable zerk fittings and grease lines extended to exterior of fan inlet collar.

E. Fan casings shall be rigidly built and braced. Bracing on the sides of the housings shall consist of structural angle iron extending the complete height of the unit. Housings with lock seams are not acceptable. Minimum gauges for Class I and Class II fans shall be as follows:

	Scroll
Sideplates	

Sizes 12" - 27" (300 mm - 6575 mm) 14 ga. (2.0 mm)
12ga (2.8 mm)

F. Class III fans shall have minimum 7 gauge (5 mm) scrolls and sideplates except for fans with smaller than 24-1/2" (620 mm) wheel diameter may have 10 gauge (3.5 mm) scrolls and sideplates. Round heavy gauge inlet collars shall be provided for all single width, single inlet fans. All fans shall have discharge flanges.

G. The fan shaft shall be designed so that first critical speed is a minimum of 1.35 times the maximum allowable speed for the fan class. Shafts shall be of solid hot-rolled steel accurately turned, ground, polished, and ring gauged for accuracy. All shafts must be dial indicated for straightness after the keyways are cut.

H. Both a static and dynamic balance shall be made on the fans after their assembly at the factory. The dynamic balance shall be made utilizing an IRD analyzer and final adjustment will be made to result in vibration amplitude not to exceed the acceptable levels on the Rathbone chart.

I. Fan performance shall be based on tests conducted in accordance with the AMCA Standard Test Code for Air Moving Devices. Fan shall be licensed to bear AMCA Certified Ratings Seal for Air and Sound. Performance curves shall be submitted for approval, and include static pressure, brake horsepower, and static efficiency plotted against air volume. Sound Power Levels by Octave Bands.

J. V-belt drives shall be selected for a minimum service factor or 1.5 at design operating speed. Fans with motors under 20 HP (15 kW) shall be furnished with adjustable V-belt drives, sized to give the required fan speed with motor sheave at the approximate midpoint of its range adjustment. Fans with motors 20 HP (15 kW) and larger shall be furnished with fixed pitch drives. Additional sheaves and belts shall be provided by the fan manufacturer at no additional cost, if required for final air balance.

K. All fans shall be furnished with flanged outlet, scroll access door and OSHA belt guard with tachometer opening at fan shaft. Fans exposed to weather shall be provided with weatherhoods over motors, shaft, bearings, and sheaves, and with drain fitting in bottom of scroll.

L. All other fan components, and all other fans, shall be thoroughly degreased and deburred before the application of a rust-preventative primer. After assembly, a second coat of enamel shall be applied to the complete assembly.

M. Fans shall be manufactured by Greenheck, Twin City, Buffalo, New York Blower or Aerovent.

2.2 INLINE CENTRIFUGAL FANS

A. Fans shall be inline fans with non-overloading backwardly inclined wheels.

B. Wheel diameters shall be in accordance with the standard sizes adopted by AMCA for non-overloading fans. Wheels shall be all aluminum construction with extra wide backwardly blades for maximum efficiency and quiet operation.

C. Bearings shall be "Air Handling Quality Bearings" with an L10-200,000 hour rating based on the maximum allowable speed range of the fan.

D. Fan housings shall be of heavy gauge galvanized steel, suitably braced to prevent vibration and pulsation. Fans with 27" (675 mm) and larger wheels shall be provided with recessed unpunched flanges on inlet and discharge. All fans shall be equipped with support brackets suitable for horizontal, vertical and all-angle mounting. Integral adjustable motor mount shall be provided in location as indicated on the drawings.

E. The fan shafts shall be designed so that first critical speed is a minimum of 1.4 times the maximum allowable fan speed. Shafts shall be of solid hot-rolled steel accurately turned, ground, polished and ring gauges for accuracy.

F. Fans shall be provided with adjustable pitch V-belt drive and OSHA belt guard. Fans shall be designed for straight-through airflow, with fan bearings, fan and motor sheaves, belts, and motor completely isolated from the airstream and exterior to the fan housing, to facilitate inspection and maintenance. Fans shall be provided with bolted access door for wheel inspection and cleaning.

G. Fan wheel shall be statically and dynamically balanced, and the complete fan assembly shall be balanced at design operating speed prior to shipment.

H. All fans shall be licensed to bear the AMCA Certified Ratings Seal. Performance curves shall be submitted for approval, and include static pressure, brake horsepower, and static efficiency plotted against air volume. Sound Power Levels by Octave Bands, based on AMCA Standard 300, shall be submitted for approval. Fan sound power levels shall not exceed those listed on the drawings.

I. Fan shall be Greenheck model SQ or equivalent.

2.3 BASE MOUNTED CENTRIFUGAL FANS

A. General:

1. Base fan performance at standard conditions (density 0.075 Lb/ft^3).

2. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

3. Each fan shall be belt drive in AMCA arrangement 10 according to drawings.

4. Normal operating temperature up to 180 Degrees Fahrenheit.

5. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model and individual serial number.

6. Fans are to be equipped with lifting lugs.

7. Constructed of heavy gauge steel.

B. Fan Housing And Outlet

1. Fan housing is to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.

2. Fan shall be of airtight construction with the scroll panel material formed and embedded into the side panels. All interior and exterior surface untreated steel shall be coated with a high-performance powder coating.

3. Housing and bearing support shall be constructed of bolted framework.

4. An OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).

C. Fan Wheel

1. The fan wheel shall be of the single width backward centrifugal type.

2. Fan Wheel shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.

3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

D. Fan Motors And Drive

1. Motor enclosures: Open drip proof.

2. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower.

3. Bearings shall be heavy-duty grease lubricated.

2.4 SIDE WALL PROPELLER FANS

A. General

1. Sidewall mounted applications

2. Maximum continuous operating temperature 130° Fahrenheit (54.4 Celsius)

3. Minimum continuous operating temperature -10° F (-23° C)

4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual unit serial number

B. Propeller

1. Propeller constructed of cast aluminum tapered airfoil blades and cast aluminum hubs

2. Securely attached to motor shaft with a standard square key, set screw and tapered bushing

3. Statically and dynamically balanced in accordance with AMCA Standard 204-05

4. The propeller and fan inlet will be aligned and shall have precise running tolerances for maximum performance and operating efficiency

C. Motors

1. Motor enclosures: Open Drip-Proof

2. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase

3. Accessible for maintenance

D. Drive Frame

1. Drive frame assemblies and fan panels shall be galvanized steel or painted steel

2. Drive frame shall be formed steel and fan panels shall have pre-punched mounting holes, formed flanges, and a deep formed inserted venturi

E. Disconnect Switches:

1. NEMA rated: 1

2. Positive electrical shut-off

3. Wired from fan motor to junction box

F. Accessories

1. Motorized damper

2. Flush interior mount wall housing

3. Galvanized steel birdscreen

2.5 MOTORS (TYPICAL FOR ALL FANS)

A. See Division-23 section, "Electrical Provisions for HVAC Equipment" for minimum motor efficiencies and other requirements.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which fans are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF FANS

A. General: Install fans where indicated, in accordance with manufacturer's installation instructions, and with recognized industry practices, to ensure

that fans comply with requirements and serve intended purposes.

B. Access: Provide access and service space around and over fans as indicated, but in no case less than that recommended by manufacturer.

C. Support: Provide 4" (100 mm) high concrete pad under floor-mounted fans.

D. Isolation: Set fans on vibration isolators, fasten in accordance with manufacturer's installation instructions.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Ensure that rotation is in direction indicated and intended for proper performance. Do not proceed with centrifugal fan start-up until wiring installation is acceptable to fan Installer.

F. Ductwork Connections: Refer to Division-23 ductwork sections. Provide flexible connections on inlet and outlet duct connections.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of fans, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

3.4 ADJUSTING AND BALANCING

A. Start-up, test, and adjust centrifugal fans in presence of manufacturer's authorized representative.

3.5 SPARE PARTS

A. General: Furnish to Owner, with receipt, one spare set of belts for each belt driven centrifugal fan.

END OF SECTION

SECTION 23 3700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section and all other Division-23 sections.

B. Types of air outlets and inlets required for project include the following:

1. Ceiling air diffusers

2. Registers and grilles

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating

Seal.

5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, Noise Criteria (NC) levels, static pressure loss, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work shall be limited to the following:

1. Titus
2. Krueger
3. Price
4. Nailor
5. Anemostat
6. Metal Air

2.2 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as a minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule:

E. Diffuser Materials:

1. Steel Construction: Manufacturer's standard stamped sheet steel frame and adjustable blades.

2. Aluminum Construction: Manufacturer's standard extruded aluminum frame and adjustable blades.

F. Diffuser Faces:

1. Square: Square housing, core of square concentric louvers, square or round duct connection. (See drawings).

2. Rectangular: Rectangular housing, core of rectangular concentric louvers, square or round duct connection. (See drawings).

3. Perforated: Square, housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.

G. Diffuser Mountings:

1. Flush: Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.

2. Lay-In: Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

H. Diffuser Patterns:

1. 1-Way: Fixed louver face for 1-direction air flow, direction indicated on drawings.

2. 2-Way: Fixed louver face for 2-direction air flow, directions indicated on drawings.

3. 3-Way: Fixed louver face for 3-direction air flow, directions indicated on drawings.

4. 4-Way: Fixed louver face for 4-direction air flow, directions indicated on drawings.

5. Induction: Internal aspirator designed to mix air drawn into center core with conditioned air.

I. Diffuser Dampers:

1. Fire Damper: Where indicated, provide combination adjustable opposed blade damper and fusible link fire damper with UL approved link and assembly designed to meet requirements of NFPA 90A.

J. Diffuser Finishes:

1. Aluminum Enamel: Air-dried aluminum enamel prime finish.

2. White Enamel: Semi-gloss white enamel prime finish.

3. Aluminum Anodize: Aluminum etched and anodized, covered with clear lacquer finish.

2.3 REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide registers and grilles that have, as a minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Surface Compatibility: Provide registers and grilles with border styles that are compatible with adjacent surfaces, and that are specifically manufactured to fit with accurate fit and adequate support. Refer to general construction drawings and specifications for types of construction which will contain each type of register and grille.

D. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register and Grille Materials:

a. Steel Construction: Manufacturer's standard stamped sheet steel frame and adjustable blades.

b. Aluminum Construction: Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Register and Grille Faces:

a. Horizontal Fixed Blades: Horizontal blades, fixed at 35 degrees, with 3/4" (20 mm) spacing. Blades shall be parallel to long dimension.

b. Aluminum Grid - Eggcrate type: 1/2" x 1/2" x 1/2" (13 mm x 13 mm x 13mm) aluminum grid and border.

3. Register and Grille Patterns:

a. Single Deflection: 1-set of blades in face.

4. Register and Grille Finishes:

a. Aluminum Enamel: Air-dried aluminum enamel prime finish.

b. White Enamel: Semi-gloss white enamel prime finish.

c. Aluminum Anodize: Aluminum etched and anodized, covered with clear lacquer finish.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions. Air outlets and inlets shall be independently supported from the structure at two (2) locations and in accordance with recognized industry practices to ensure that products serve intended functions. The ceiling or ceiling grid shall not be considered as a means of support.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

D. Provide MERV 13 filter media at all return air inlet locations throughout the duration of construction. Filter media shall not be removed until final filters are installed in the air handling units.

END OF SECTION

SECTION 23 5100 - BREECHING AND STACKS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of breeching and stack work required by this section is indicated on the drawings, by requirements of this section and all other Division-23 sections.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide breechings and stacks conforming to the following:

1. American Institute of Steel Construction (AISC): Provide all structural materials for rectangular breeching complying with applicable sections of AISC S326, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings."

2. American Welding Society, Inc. (AWS): Welds shall conform to AWS D1.1, "Structural Welding Code, Steel."

3. National Fire Protection Association (NFPA): Provide breeching constructed and installed in accordance with NFPA Standard 211.

4. Underwriters Laboratories (UL): All products and assemblies shall be in accordance with UL Standards including, but not limited to: UL 103, 441 and 1738.

5. Source Limitations: Obtain listed components through one source from a single manufacturer.

6. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings for breechings and stacks.

1. Draw to a scale of 1/4-inch to 1 foot (6 mm to 300 mm), with sheet size equal to Contract Drawings.

2. Show plan, sections, elevations, details of all joints, and attachments to other work.

3. Detail cleanout door, access doors, and floor and roof penetrations.

4. Indicate metal gauge on the drawings.

5. Show all hangers and supports.

6. Calculations to include, but not be limited to, pressure drop, maximum temperature at stack discharge, flow rate, etc.

B. Vent Systems Sizing Calculations: Computer calculated sizing analysis for the boilers and/or water heaters being furnished. The computer analysis shall include the make, model number, firing rate and allowable back pressure for each vented appliance. The analysis shall also include drawing detailing the vent system layout including lengths, number of fittings and sizes. Where applicable expansion calculations and expansion joint selection shall also be included.

C. Manufacturer Seismic Qualification Certification: Submit certification that the breeching and stack components will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

   b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without

separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Handle breeching and stack components carefully to prevent damage, denting and scoring. Do not install damaged components; replace with new.

1.5 WARRANTY

A. Warranty: Manufacturer shall repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

B. Warranty period shall be 10 years from date of Substantial Completion, including all parts and labor.

PART 2 - PRODUCTS

2.1 BUILDING-HEATING-APPLIANCE CHIMNEYS (CATEGORY II AND IV – ATMOSPHERIC AND\OR FORCE DRAFT)

A. Listed Special Gas Vents – Condensing Equipment:

1. Description: The factory built modular chimney shall be laboratory tested and listed in accordance with Underwriters Laboratories Standard UL 1738 for use with category II, III, and IV appliances with a maximum flue gas temperature of 550°F and ULC-S636-95 for gas vent – BH, Class I/Class II 245°C. Products listed "to" UL standards by other testing agencies are not allowed.

2. Construction: Between the inner and outer shells there shall be a minimum of a 1" air gap. Stainless steel centering clips shall be welded to the outer shell to maintain the 1" spacing and ensure concentricity of the shells. Vent sections shall be sealed with banded flanges and silicone joint sealant for temperatures up to 600°F with a UL tested pressure rating of 40" w.c.

3. Assembly: Pipe sections must be joined using factory supplied solid vee-bands only for structural and liquid-tight integrity. Products joined utilizing a method other than a vee banded connection, or

those using perforated vee bands, will not be accepted.

4. Inner liner material shall be AL29-4C stainless steel. Inner liner thickness shall be .024" (24 ga.) All inner shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted on any part or fitting.

5. Outer shell material shall be aluminized steel with a thickness of .034" for 5" to 36" diameter systems and .052" for 37" to 48" systems. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted. Chimney sections exposed to atmospheric conditions shall have outer shells of type 430 stainless steel.

6. 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.

7. All intake piping to be PVC unless as specified per appliance manufacturer.

8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Schebler Chimney Systems – Model eVent

   b. Pro-Tech

   c. Z-Flex

2.2 BUILDING-HEATING-APPLIANCE CHIMNEYS (CATEGORY III – GAS FORCE DRAFT, NON-CONDENSING)

A. Positive Pressure, Non Condensing Equipment:

1. Description: The factory built modular chimney shall be laboratory tested and listed in accordance with Underwriters Laboratories Standard UL 103 for use with building heating equipment burning gas, solid or liquid fuels with flue gases not exceeding 1400°F continuous operations and 1800°F intermittent operation.

2. Assembly: Pipe sections must be joined using a 1\2" flange connection with factory supplied vee bands and joint sealant. Products using perforated vee bands, will not be accepted.

Alternate Design: Pipe sections shall be made of two steel cylinders separated by 2 inches of air between and incorporate special, integral, flanged male and female couplers that maintain concentricity of the two cylinders and extend out to the outer wall, permitting attachment and sealing of the system via a single V-shaped profile locking band that secures the sections together.

3. Construction: Between the inner and outer shells there shall be a minimum 1" of air gap with minimum 1" fiberglass insulation. Stainless steel centering clips shall be welded to the outer shell to maintain the 1" spacing and ensure concentricity of the shells.

   Alternate Construction: Between the inner and outer shells there shall be a minimum 2" of air gap insulation.

4. Inner Shell: Inner shell material shall be type 304 stainless steel for natural gas and number 2 oil fired appliances, type 316 stainless steel for coal, number 4 and number 6 oil fired appliances. Inner shell thickness shall be .036" for 5" to 36" diameter systems and .048" for 37" to 48" diameter systems. All inner shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted

5. Outer Jacket: Outer shell material shall be aluminized steel with a thickness of .034" for 5" to 36" diameter systems and .052" for 37" to 48" systems. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted.

6. Aluminized steel surfaces exposed to the elements shall be protected by a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for outer jacket skin temperatures of the given application. All primer and paint to be supplied by the installing contractor and shall be equivalent to series 4100 or 9400 as manufactured by Rust-Oleum. Alternatively, an outer jacket constructed of 304 or 316 stainless steel may also be considered in lieu of painting.

7. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Schebler Chimney Systems – Model P Series

b. Simpson DuraVent

c. Ampco Stacks, Hart & Cooley

d. Metal-Fab - Corr Guard

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install breechings and stacks as shown on the drawings and in accordance with the boiler manufacturer's instructions for installation.

B. Examine areas and conditions for compliance with requirements for installation tolerance and other conditions affecting performance of work.

C. Installation of Listed Vents, Exhaust and Chimneys:

1. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

2. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

3. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

4. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

5. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.

6. Stacks: Install stacks projecting above the roof not less than that indicated on the drawings.

a. Substantial structural steel framework shall be provided at the roof around each stack and attached to roof joints to brace stack against swaying and to support new roof curb and stub stack.

b. When rain can fall into contact with internal boiler parts, stacks shall be provided with rain caps or hoods.

c. Curb openings shall be provided in roof and shall be properly flashed and counterblocked to roofing. Flashing hoods shall be furnished and installed around stacks and over roof curbs.

D. Cleaning:

1. After completing system installation, including all outlet fittings and devices, inspect all exposed finishes. Remove burrs, dirt, and construction debris and repair damaged finishes.

2. 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 touch-up to match factory or shop finish.

3. Provide temporary closers at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION

SECTION 23 5216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of condensing boiler work required by this section is indicated on drawings and schedules, and by requirements of this section and all other Division-23 sections.

B. Refer to requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:

1. I=B=R Compliance: Provide condensing boilers that have been tested and rated in accordance with Institute of Boiler and Radiator Manufacturers (I=B=R) "Testing and Rating Standard for Cast-Iron and Steel Heating Boilers", and bear I=B=R emblem on nameplate affixed to boiler.

2. NFPA Compliance: Install gas-fired condensing boilers in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".

3. ASME Compliance: Construct condensing boilers in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section IV and provide low water cut-off as per ASME CSD-1.

4. UL Labels: Provide condensing boiler ancillary electrical components which have been listed and labeled by Underwriters Laboratories (UL).

B. State Requirements: Comply with requirements of the State of Maryland.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagram: Submit ladder-type wiring diagrams for power and wiring required for final installation of condensing boilers and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts list for each condensing boiler, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual.

E. Manufacturer Seismic Qualification Certification: Submit certification that the boilers and accessories will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

    b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle condensing boiler sections and equipment carefully to prevent damage, breaking, and scoring. Do not install damaged sections or components; replace with new.

B. Store condensing boiler sections and equipment in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 CONDENSING BOILERS

A. Manufacturers:

1. Provide Lochinvar Knight FTXL Boiler or approved equal by Fulton or Cleaver Brooks.

B. Construction:

1. 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.

2. 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. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Cast iron, aluminum, or condensing copper tube boilers will not be accepted.

3. Efficiency: Boilers shall have an AHRI certified minimum thermal efficiency of 97 percent.

4. Condensate Collection Basin: Fully welded 316L stainless steel and shall include a stainless steel combustion analyzer test port.

5. Pressure Vessel: The pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The pressure vessel shall be

designed for a single-pass water flow to limit the water side pressure drop. The pressure vessel shall contain a volume of water no less than 12 gallons.

6. Burner: Natural gas, forced draft single burner premix design. The burner shall be high temperature stainless steel with a woven Fecralloy outer covering to provide modulating firing rates. The burner shall be capable of the stated gas train turndown without loss of combustion efficiency.

7. Blower: Boiler shall be equipped with a pulse width modulating blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation.

8. Gas Train: The boiler shall be supplied with a negative pressure regulation gas train and shall be capable 7:1 turndown.

9. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

10. Casing:

    a. Jacket: Heavy gauge primed and painted steel jacket with snap-in closures.

    b. Control Compartment Enclosures: NEMA 250, Type 1A.

    c. Insulation: Minimum ½ inch thick, mineral fiber insulation surrounding the heat exchanger.

    d. Combustion-Air Connections: Inlet and vent duct collars.

11. Characteristics and Capacities:

    a. Heating Medium: Hot water.

    b. Design Water Pressure Rating: 160 psi working pressure.

    c. Safety Relief Valve Setting: 50 psig

    d. Minimum Water Flow Rate shall be 15-18 gpm.

C. Trim:

1. Safety Relief Valve:

a. Size and Capacity: 50 lb.

b. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

2. Pressure Gage: Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.

3. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection.

4. Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.

D. Controls:

1. Boiler controls shall feature a standard, factory installed multi-color graphic LCD screen display with navigation dial and includes the following standard features:

a. Boiler shall have the ability to communicate remotely via a wireless or Ethernet connection.

b. Variable Speed Boiler Pump Control: Boiler may be programmed to send a 0-10V DC output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the heat exchanger. The boiler shall be able to operate in this mode with a minimum temperature rise of 20 degrees F and a maximum temperature rise of 60 degrees F.

c. Password Security: Boiler shall have a different password security code for the User and the Installer to access adjustable parameters.

d. Outdoor air reset: Boiler shall calculate the set point using a field installed, factory supplied outdoor sensor and an adjustable reset curve.

e. Pump exercise: Boiler shall energize any pump it controls for an adjustable time if the associated pump has been off for a time period of 24 hours.

f. Four pump control: Boiler shall have the ability to control the boiler pump and a system pump.

g. Ramp delay: Boiler may be programmed to limit the firing rate based on six limits steps and six time intervals.

h. Boost function: Boiler may be programmed to automatically increase the set point a fixed number of degrees (adjustable by installer) if the setpoint has been continuously active for a set period of time (time adjustable by installer). This process will continue until the space heating demand ends.

i. PC port connection: Boiler shall have a PC port allowing the connection of PC boiler software.

j. Time clock: Boiler shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.

k. Maintenance reminder: Boiler shall have the ability to display a yellow colored, customizable maintenance notification screen. All notifications are adjustable by the installer based upon months of installation, hours of operation, and number of boiler cycles.

l. English Error codes: Boiler shall have a user interface that displays a red error screen with fault codes that are displayed in English and include a date and time stamp for ease of servicing.

m. Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.

n. Space Heating Night setback: Boiler may be programmed to reduce the space heating temperature set point during a certain time of the day.

o. Freeze protection: Boiler shall turn on the boiler and system pumps when the boiler water temperature falls below 45 degrees. When the boiler water temperature falls below 37 degrees the boiler will automatically turn on. Boiler and pumps will turn off when the boiler water temperature rises above 43 degrees.

p. Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.

q. BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.

r. Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, space heat run hours, domestic hot water run hours and ignition attempts. All data should be visible on the boiler screen.

2. The boiler shall have a built in controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs without utilization of an external controller. The factory installed, internal cascade controller shall include:

a. Lead lag: The Control module shall allow only one boiler to fire at the beginning of a call for heat. Once the lead boiler is in full fire and the control calculates that additional heat is required it will call on an additional boiler as needed.

b. Efficiency optimization: The Control module shall allow multiple boilers to simultaneously fire at minimum firing rate in lieu of Lead/Lag.

c. Front end loading: The Control module shall allow the cascading and functional control of several non condensing Lochinvar products alongside the Knight FTXL.

d. Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours.

3. Boiler operating controls shall include the following devices and features:

a. Set-Point Adjust: Set points shall be fully adjustable by the installer.

b. Sequence of Operation: Factory installed controller to modulate burner firing rate to maintain system water temperature in response to call for heat.

4. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation and include:

    a. High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.

    b. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.

    c. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.

    d. High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.

    e. Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.

    f. Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface.

    g. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for any lockout conditions.

5. Building Automation System Interface:

    a. Unit controller shall be BACnet compatible.

    b. Boiler shall have the ability to receive a 0-10V system from a building management system and control by the following:

        1) 0-10V DC input to control Modulation or Setpoint

        2) 0-10V DC input from Variable speed Boiler pump

        3) 0-10V DC output signal to a Variable speed system pump

        4) 0-10V DC input Enable/Disable signal

    c. Factory installed Modbus gateway interface to enable building automation system to monitor, control, and display boiler status and alarms.

E. Electrical Power:

1. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2. 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.

F. Venting:

1. Exhaust flue must be Category IV approved PVC, CPVC, PP or 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.

2. Intake piping must 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.

3. Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.

4. Boilers using common venting must only include like models and the optional common vent damper. Contact the factory for common vent sizing.

5. Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD display.

6. Refer to manufacturer's Installation and Operations manual for detailed venting instructions and approved manufacturers.

G. Source Quality Control:

1. 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.

2. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which condensing boilers are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CONDENSING BOILERS

A. General: Comply with boiler manufacturer's instructions for installation, except as otherwise indicated.

B. Comply with installation requirements of local and state boiler codes, and applicable provisions of NFPA and ASME boiler code standards.

C. Install condensing boilers on 4" (100 mm) high concrete pad where indicated, maintain manufacturer's recommended clearances around and over top of boilers.

D. Install boiler trim not installed at the factory.

E. Connect water, fuel, blowdown piping, and breeching as indicated.

F. Furnish to Electrical Installer, manufacturer's wiring diagram and electrical requirements for installation of field-wiring required for condensing boilers; not work of this section.

G. Flush and clean condensing boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

H. Start-up condensing boilers, in accordance with manufacturer's start-up instructions, and in presence of boiler manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

I. Hydrostatically test assembled boiler and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

J. Arrange with National Board of Boiler and Pressure Vessel Inspectors for inspection of boiler piping, observation of hydro-static testing, and for certification of completed boiler units.

K. 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.

END OF SECTION

SECTION 23 7310 - INDOOR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of indoor air handling unit work required by this section is indicated on drawings and schedules, and by requirements of this section and all other Division-23 sections.

B. Types of indoor air handling units specified in this section include the following:

1. Indoor air handling units

C. Refer to requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:

1. ARI Compliance: Provide capacity ratings for indoor air handling units in accordance with ARI Standard 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".

2. ASHRAE Compliance: Construct refrigerating system of indoor air handling units in accordance with ASHRAE Standard 15 "Safety Code for Mechanical Refrigeration".

3. UL Compliance: Provide indoor air handling units which are designed, manufactured, and tested in accordance with UL requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for indoor air handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts list for each heating and cooling unit, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division-01.

A. Manufacturer Seismic Qualification Certification: Submit certification that the dedicated outdoor air system (DOAS), accessories, and components will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

   b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle indoor air handling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged indoor

air handling units or components; replace with new.

B. Store indoor air handling units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading indoor air handling units, and moving them to final location.

PART 2 - PRODUCTS

2.1 INDOOR AIR HANDLING UNITS (DOAS-1)

A. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake hood with 2" aluminum mesh filter assembly, evaporator coil, condensate drain pan, Energy wheel, hot gas reheat coil, indirect gas furnace, split DX system with remote air-cooled condenser, phase and brownout protection, motorized dampers, sensors, filter assembly for intake air, supply air blower assembly, exhaust/relief blower assembly and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection except with electric post heat and exhaust fan only power if dual point power is selected.

B. Cabinet

1. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance..

a. Internal assemblies: 24 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.

2. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.

a. Materials: Rigid urethane foam

1) Thickness: 2 inch (50 mm)

2) Meets UL94HF-1 flame requirements

3) Location and application: Full coverage of entire exterior to include walls, roof of unit, unit base and doors

3. Access panels / doors: Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge galvanized G90 steel or painted galvannealed steel.

4. Supply Air blower assemblies: Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.

5. Exhaust Air blower assemblies: Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.

6. Evaporator Coil: Evaporator coil shall be AHRI Certified and shall be (silver) soldered or brazed into the compressed refrigerant system. Coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame. If two compressors are used as components of the unit, then the evaporator coil shall be of "interlaced" configuration, permitting independent operation of either compressor without conflict with the other compressor.

7. Control panel / connections: Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. The DOAS shall be equipped with a Unit Disconnect Switch.

8. Condensate drain pan: Drain Pan shall be an integral part of the unit whenever a cooling option is included. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.

9. P trap: If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.

10. Energy wheel: Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel

cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt with a five year warranty. The wheel media shall be a polymer film matrix in a stainless steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and is designed and constructed to permit cleaning and servicing. The energy wheel is to have a five year warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.

11. Modulating frost control. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.

12. Reheat Coil with factory installed modulating hot gas reheat valve

    a. Shall be ETL Certified as a component of the unit.

    b. Shall have an integral combustion gas blower.

    c. Shall be ETL Certified for installation downstream of a cooling coil.

    d. Shall have fault sensors to provide fault conditions to optional digital controller or building controls.

    e. Shall have 4-pass tubular heat exchangers, constructed of type 409 stainless steel. Heat exchanger tubes shall be installed on the vest plate by means of swaged assembly, welded connections are not acceptable. Heat exchanger tubes shall be supported by a minimum of two fabricated assemblies that support the tubes and also permit expansion and contraction of the tubes.

    f. Heat exchanger shall have a 10 year extended warranty.

    g. Furnace control shall be High Turndown 16:1 Modulating.

    h. Shall be encased in a weather-tight metal housing with intake air vents. Large, metal lift-off door shall provide easy access to the enclosed vest plate, control circuitry, gas train, burner assembly and exhaust blower.

i. Shall have solid state controls permitting stand-alone operation or control by building controllers.

13. Split System DX with Remote Condenser: Main unit shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing. Condenser coils and appurtenant condenser fans shall be factory assembled as a single remote unit and require field installation separate from the main unit. Condenser fans shall feature swept blade design resulting in reduced sound levels. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal protector. Lead condenser fan will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point. Motors shall be UL Recognized and CSA Certified. The lead refrigerant compressor(s) shall be digital hermetic scroll-type. Compressors shall be equipped with liquid line filter drier, expansion valve, manual reset high pressure and low pressure cutouts and all appurtenant sensors, service ports and safety devices. Remote condenser and associated main unit shall ship with a nitrogen holding charge. Each compressor shall be factory-equipped with an electric crankcase heater to boil off liquid refrigerant from the oil. Each compressor shall be factory-equipped with an electric crankcase heater to boil off liquid refrigerant from the oil.

14. Packaged DX Control and Diagnostics: The Packaged DX system shall be controlled by an onboard digital controller (DDC) that indicates both owner-supplied settings and fault conditions that may occur. The DDC shall be programmed to indicate the following faults:

    a. Global alarm condition (active when there is at least one alarm)

    b. Supply Air Proving alarm

    c. Dirty Filter Alarm

    d. Compressor Trip alarm

    e. Compressor Locked Out alarm

    f. Supply Air Temperature Low Limit alarm

    1) Sensor #1 Out of Range (outside air temperature)

2) Sensor #2 Out of Range (supply air temperature)

3) Sensor #3 Out of Range (cold coil leaving air temperature)

15. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.

16. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.

C. Blower

1. Blower section construction Supply Air: direct drive motor(s) and blower(s) shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.

2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

3. Fan: Direct drive, airfoil plenum fan with painted steel wheels statically and dynamically balanced and AMCA certified for air and sound performance.

4. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating."

D. Motors

1. General: Blower motors greater than ¾ horsepower shall be "NEMA Premium™" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.

E. Unit Controls

1. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors, or it can be operated as a

heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.

2. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.

3. Unit supply fan shall be configured for Constant Volume (ON/OFF).

4. Unit exhaust fan shall be configured for Constant Volume (ON/OFF).

5. Outside Air / Return Air damper control shall be

6. Operating protocol: The DDC shall be factory-programmed for BACNetMSTP.

7. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the supply and exhaust air blower assemblies. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.

F. Filters

1. Unit shall have permanent metal filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 8 disposable pleated filters shall be provided in the supply air stream. MERV 8 and MERV 13 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which indoor air handling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF INDOOR AIR HANDLING UNITS

A. General: Install indoor air handling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install units on 4" high concrete pad, 4" larger on each side than equipment base. Cast anchor bolt inserts into pad.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

D. Ductwork: Refer to Division-23 ductwork sections. Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.

1. Connect outside air duct to unit with flexible connection, provide manual damper, quadrant and lock.

2. Connect condenser supply and exhaust ducts to unit with flexible connections.

E. Condenser Piping: Refer to Division-23 section "Refrigerant Piping". Connect liquid and suction piping to unit as indicated.

F. Drain Piping: Connect unit drain to nearest indirect waste connection. Provide trap at drain pan; construct at least 1" deeper than fan pressure in inches of water.

G. Start-up indoor air handling units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.3 TRAINING OF OWNER'S PERSONNEL

A. Provide services of manufacturer's technical representative for one (1) half day to instruct Owner's personnel in operation and maintenance of indoor air handling units.

1. Schedule training with Owner, provide at least seven (7) day notice to Contractor and Engineer of training date.

3.4 SPARE PARTS

A. General: Furnish to Owner, with receipt, the following spare parts for each heating and cooling unit:

1. One set of matched fan belts for each belt driven fan.

2. One set of filters for each unit.

END OF SECTION

SECTION 23 8119 - ENVIRONMENTAL CONTROL AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of environmental control air conditioning unit work required by this Section is indicated on drawings and schedules, by requirements of this Section, and all other Division-23 Sections.

B. Refer to requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Manufacturer: Provide environmental control air conditioning units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be field fabricated.

B. Certifications: Submit certified technical and test data indicating compliance with the capacities specified.

C. Codes and Standards: Provide environmental control air conditioning units conforming to the following:

1. Air-Conditioning and Refrigeration Institution (ARI): Comply with ARI 240.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Construct and install refrigerant coils in accordance with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

3. National Electrical Manufacturers Association (NEMA): Provide electrical components required as part of environmental control air conditioning units, which comply with NEMA Standards.

4. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code" as applicable to installation and electrical connections of ancillary electrical components of environmental control air conditioning units.

5. Underwriters Laboratories, Inc. (UL): Provide electrical components required as part of environmental control air conditioning units,

which have been listed and labeled by UL.

D. Certifications: Submit certified technical and test data indicating compliance with the capacities specified.

E. Manufacturer Seismic Qualification Certification: Submit certification that the ductless split systems and accessories will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data for air conditioning units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, and installation instructions.

B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts list. Include this data, product data, shop

drawings, and wiring diagrams in maintenance manuals in accordance with requirements of Division-01.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver environmental control air conditioning unit with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handling: Handle environmental control air conditioning units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components. Replace damaged units with new units.

C. Storage: Store environmental control air conditioning units in a clean, dry place and protect from weather and construction traffic.

D. Unloading: Comply with manufacturer's rigging instructions for unloading air conditioning units and condensing units, and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work will be limited to:

1. Daikin
2. Panasonic
3. Mitsubishi
4. Samsung
5. York/Johnson Controls

2.2 ENVIRONMENTAL CONTROL AIR CONDITIONING UNITS

A. General: Provide factory assembled air conditioning system complete with split system compact wall mounted packaged evaporator section and matching outdoor unit. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label. All wiring shall be in accordance

with the National Electrical Code (NEC). The units shall be rated in accordance with ARI Standard 240 and bear the ARI label. A full charge of R-410A for 100 feet of refrigerant tubing shall be provided in the condensing unit. A dry nitrogen holding charge shall be provided in the evaporator. System SEER shall meet or exceed 1992 Federal Standards.

B. Capacities: Provide environmental control air conditioning units of capacity and type as indicated on the drawings and schedules.

C. Warranty: The units shall have a manufacturer's warranty for a period of one (1) year from date of installation. The compressor shall have a warranty of six (6) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced at the contractor's expense. Manufacturer shall have ten (10) years' experience in the U.S. market.

D. Components: Provide environmental control air conditioning units that draw air through filter and coils, and that include fans, compressors, cooling coils, reheat coils, filters, remote air cooled condensing units, motors, starters, controls, condensate pump, and all other components necessary for proper operation.

1. Units shall be furnished complete with remote air cooled condensing unit factory assembled and tested by manufacturers of environmental control air conditioning units.

2. For units installed above ceiling, provide a secondary drain pan with leak detection. Leak detection shall alarm at the building automation system (BAS) and shall de-energize the unit.

E. Indoor Evaporator Unit: The indoor evaporator unit shall be factory assembled and wired. The casing shall have a white finish. The evaporator fan shall be an assembly with line flow fans direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings. An adjustable guide vane shall be provided with the ability to change the air flow from horizontal to vertical. A motorized air sweep flow louver shall provide an automatic change in air flow by directing the air from side to side for uniform air distribution. Return air shall be filtered by means of an easily removable washable filter. The evaporator coil shall be of non-ferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The unit electrical power shall be 208 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.

F. Control System: The control system shall consist of two (2) microprocessors interconnected by a single non polar two wire cable as supplied. Wiring shall run from indoor unit to controller direct. NO SPLICES. When running longer lengths or more than one (1) set of remote controller wires together, a double insulated, two wire cable equivalent to that provided e.g. Belden 9407 cable, is mandatory or use shielded two-wire cable. One (1) microprocessor shall be factory wired and located within the indoor unit. It shall have the capability of sensing return air temperature and indoor coil temperature; receive and process commands from the remote controller; provide emergency operation; and control the outdoor unit. The microprocessor within the wall mounted remote controller shall provide automatic cooling; display setpoint and room temperature; a 24 hour on/off timer so that automatic operation can be set on the timer at one (1) hour intervals from one to twenty-four hours; have self-diagnostic function display; check mode for memory of most recent problem; control system shall have control continued operation of the air sweep louvers; and provide on-off and system/mode function switching. Normal operation of the remote controller provides individual system control in which one (1) remote controller and one (1) indoor unit are installed in the same room. The remote controller shall have the capability of controlling up to a maximum of fifty (50) systems at a maximum developed control cable distance of 1,650 feet. The control voltage between the remote controller and the indoor unit shall be 12 volts D.C. The control voltage between the indoor unit and the outdoor unit shall be 12 volts D.C. Both 12VDC shall be generated from the indoor unit microprocessor board. The system shall be capable of automatic restart when power is restored after power interruption. System shall include twenty (20) function self-diagnostics including total hours of compressor run time.

G. Outdoor Unit: The outdoor unit shall be completely factory assembled, piped and wired. The casing shall be fabricated of galvanized steel, bonderized and finished with baked enamel. The unit shall be furnished with one (1) direct drive, propeller type fan arranged for horizontal discharge. The motors shall have inherent protection, be of the permanently lubricated type and resiliently mounted for quiet operation. The fans shall be provided with a raised guard to prevent contact with moving parts. The compressor shall be of the high performance rotary type with crankcase heater, accumulator and internal thermal overloads. The compressor shall be mounted so as to avoid the transmission of vibration. The refrigeration system shall be equipped with high pressure switch and have the capability to operate with a maximum height difference of 100 feet and overall refrigerant tubing length of 100 feet between indoor and outdoor sections without the need for line size changes, traps or additional oil. Refrigerant flow from the condenser to be controlled by means of a capillary tube. The condenser coil shall be

of non-ferrous construction with smooth plate fins bonded to copper tubing. The coil shall be protected with smooth plate fins bonded to copper tubing. The coil shall be protected with an integral metal guard. The unit shall be controlled by the microprocessor located in the indoor matching unit. A built-in, low ambient controller will allow cooling to 0 degrees F outdoor temperature. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.

H. Wind Baffle: To allow cooling operation in temperature down to zero degrees Fahrenheit, a wind baffle must be installed onto the condensing unit.

I. Condensate Pump: Provide integral condensate pump and condensate reservoir for automatic condensate removal. Provide with condensate high level alarm.

J. Electrical Wiring: Provide all electrical circuits in conformance with NFPA 70 and color coded for ease in field tracing.

K. Provide five (5) year parts and labor warranty for A/C condensing units.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL CONTROL AIR CONDITIONING UNIT INSTALLATION

A. General: Install environmental control air conditioning units where indicated on the drawings in accordance with equipment manufacturer's published installation instructions.

B. Access: Provide access space around environmental control air conditioning units for service as indicated on the drawings, but in no case less than that recommended by the manufacturer.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but specified to be factory-mounted. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections.

D. Refrigerant Piping: Provide field installed refrigerant piping in accordance with Division-23 section, "Refrigerant Piping."

1. Field installed refrigerant piping shall be refrigerant grade, Type L seamless copper tubing.

2. All connections and joints shall be silver soldered or brazed.

3. Pipe sizing and installation details shown on drawings shall be verified by the manufacturer. Piping shall be installed in strict accordance with manufacturer's recommendations regarding sizing and installation details.

E. Piping Connections: Provide piping, valves, accessories, gauges, supports, and flexible connections as indicated on the drawings.

3.2 START-UP

A. General: Start and adjust all units installed under this specification under the supervision of an authorized factory trained representative of the manufacturer of each unit. Perform operational checks to make certain that controls and safety devices and systems are operating properly. If defects or improper adjustments are found, they shall be corrected and tests repeated.

1. An operational check shall be made to demonstrate compliance with contract requirements, including but not limited to, capacity and control accuracy.

2. A report signed by each factory representative shall be submitted showing test conditions and results.

END OF SECTION

SECTION 23 8120 - VARIABLE REFRIGERANT VOLUME SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of variable refrigerant volume system work required by this Section is indicated on drawings and schedules, by requirements of this Section, and all other Division-23 Sections.

B. Refer to the requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Manufacturer: Provide system components that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be field fabricated.

B. Contractor to provide a complete working Variable Refrigerant Volume (VRV) system including all system components and electrical and plumbing systems required for a fully functioning system that will provide space conditions according to the requirements as indicated by ASHRAE for standard indoor conditions. Only three (3) system manufacturers are listed as acceptable for use in this building. Contractor and manufacturer shall determine the specific equipment requirements of each manufacturer in order to satisfy the space conditions as determined by ASHRAE. Throughout this specification section, the term Variable Refrigerant Flow (VRF) shall be the equivalent of VRV.

C. Certifications: Submit certified technical and test data indicating compliance with the capacities specified.

D. Codes and Standards: Provide system components conforming to the following:

1. Air-Conditioning and Refrigeration Institution (ARI): Comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."

2. Air Movement and Control Association, Inc. (AMCA): Comply with AMCA 210, "Laboratory Methods of Testing Fans for Rating Purposes."

3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Construct and install refrigerant coils in

accordance with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

4. National Electrical Manufacturers Association (NEMA): Provide electrical components required as part of computer room air conditioning units, which comply with NEMA Standards.

5. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code" as applicable to installation and electrical connections of ancillary electrical components of computer room air conditioning units.

6. Underwriters Laboratories, Inc. (UL): Provide electrical components which have been listed and labeled by UL.

1.3 SUBMITTALS

A. Conform to the requirements of Division-01 Section, "Submittals," where applicable.

B. Product Data: Submit manufacturer's product data for air conditioning units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, and installation instructions.

C. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts list. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals in accordance with requirements of Division-01.

D. Manufacturer Seismic Qualification Certification: Submit certification that the VRF indoor units, branch selector boxes, and outdoor units will withstand seismic forces as defined in ASCE 7. Refer to Division 23 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and

describe mounting and anchorage provisions.

b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver system components with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handling: Handle system components carefully to avoid damage to components, enclosures, and finish. Do not install damaged components. Replace damaged units with new units.

C. Storage: Store system components in a clean, dry place and protect from weather and construction traffic.

D. Unloading: Comply with manufacturer's rigging instructions for unloading system components, and moving them to final location.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Variable Refrigerant Flow (VRF) HVAC system shall be a direct expansion (DX) heat recovery system. The outdoor unit shall consist of one or more frames (modules) connected through common refrigerant piping and control communication wiring. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or mixed combinations) through a common refrigerant piping network and integrated system controls and communication network.

B. Heat recovery systems shall be a three-pipe design with the system ability to heat or cool simultaneously. The outdoor unit shall be an air-cooled condensing unit with vertical discharge that uses refrigerant R-410A. The condensing unit may connect an indoor evaporator capacity up to 150% of the condensing unit capacity without any special factory approval. All zones are each capable of operating separately with individual temperature control.

C. Each indoor unit shall be controlled individually or as a group. Heat recovery systems shall operate in either the heating or cooling mode and shall support simultaneous heating and cooling mode.

D. The condensing unit shall be interconnected to indoor units in accordance with the manufacturer's engineering manual detailing each available indoor unit. The indoor units shall be connected to the condensing unit utilizing manufacturer recommended piping joints and headers to ensure correct refrigerant flow and balancing. T-style joints are not acceptable for a variable refrigerant system.

E. Heat Recovery Boxes (also referred to as branch selectors or change-over boxes) shall be located as shown on the drawing(s). The Heat Recovery Boxes shall control the operational mode of the subordinate indoor units.

F. VRF system performance shall be rated in accordance with AHRI 1230.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work shall be limited to the following:

1. JCI
2. Daikin
3. Samsung
4. Trane

2.3 REFRIGERANT PIPING

A. All refrigerant piping shall be installed in accordance with manufacturer's recommendations. No additional sight glasses or filter/dryers shall be required. All field installed refrigerant piping shall be nitrogenized ACR copper tubing and shall meet ASTM B280. All branch piping joints shall be

approved by the manufacturer. The three-phase VRF system shall be capable of the following refrigerant piping lengths:

1. Total system piping length: 3,280 ft.

2. Maximum piping length from refrigerant piping branch to indoor unit: 131 ft.

3. Maximum piping length from first branch to furthest indoor unit: up to 295 ft.

4. Maximum vertical separation from outdoor unit to indoor unit, when outdoor unit is above: 360 ft.

5. Maximum vertical separation from outdoor unit to indoor unit, when outdoor unit is below: 360 ft.

2.4 DEVELOPMENT GENERATIONS

A. All three-phase VRF outdoor units connected to the same piping system shall be from the same product development generation. Mixing of outdoor units from different development generations in the same piping system is not acceptable. Change-over Boxes and outdoor units in a system must be of the same product development generation.

2.5 LOW AMBIENT AIR TEMPERATURES

A. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions. Operations outside of these conditions are possible and may involve non-continuous operations.

1. Outdoor Unit

a. Cooling: 23°F DB to 122°F DB

b. Heating: -13°F WB to 59°F WB

2.6 GENERAL FEATURES

A. The air-conditioning system shall use R410A refrigerant.

B. The system shall be capable of an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed into the system.

C. Each system shall consist of one or multiple air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.

D. Multiple frame configurations shall be field piped together using manufacturer-designed and supplied Y-branch kits and field-provided interconnecting pipe to form a common refrigerant circuit.

E. Refrigerant circuit configuration

1. The refrigerant circuit shall be constructed using field-provided ACR copper, de-hydrated, and piped together with manufacturer-supplied Y- branches or headers connected to multiple (ducted, non-ducted or mixed combination indoor units to effectively and efficiently control heating or cooling operation of the VRF system. Other pipe materials shall not be allowed.

F. Each refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. Insulation R-value (thickness) shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be allowed to be compressed at any point in the system.

G. The condensing unit will be factory charged with R-410A.

H. Depending on the size and length of the piping when installed, it may require additional trim charging in the field.

I. The condensing unit shall include a refrigerant charge volume analyzer that includes an automatic refrigerant assessment system to check whether or not the correct amount of refrigerant charge exists in a given refrigerant cycle.

2.7 ELECTRICAL

A. The condensing unit power supply shall be 208V 3 phase, 60 Hertz per schedule.

B. The condensing unit shall have an acceptable voltage range of 187-253V.

C. The control circuit between the condensing unit, changeover boxes, and indoor units shall use AWG18-2 type control wire.

2.8 SAFETY

A. The condensing unit shall include protection devices including a high pressure switch at 4.15 MPa (601psi), over current protection for the inverter and for the PCB, and over heat protection for the inverter and the compressor.

2.9 OUTDOOR UNIT SYSTEM

A. The VRF outdoor unit shall be interconnected to the indoor units with capacities from 6,000 Btu/h to 96,000 Btu/h. Each VRF indoor unit or selected group of indoor units shall be capable of operating in independently and be able to provide set temperatures through a wide variety of control components central station, computerized controller, and BACnet adapter; a VRF Smart Gateway (BACnet) compatible device that makes the VRF viewable from all BACnet IP BMS/BAS systems; a Web interface and automatic point mapping to the BMS; a VRF Cloud Gateway Device – VRF accessed through mobile device (tablet/phone using Android/iOS operating system); and a VRF compatible with thermostat.

B. All components (compressor, controls, etc.) in the Outdoor Unit shall be easily accessible from the front for service/replacement.

C. General: Provide condensing unit factory assembled with pre-wired electronic and refrigerant controls, specifically designed for variable refrigerant volume (VRV) applications. Provide all components required for a complete and operational system.

D. Capacities: Provide condensing units of capacity and type as indicated on the drawings and schedules.

E. Components: The refrigeration circuit of the condensing unit shall consist of a rotary compressor, motors, fans, condenser coil, electronic expansion valve, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut-off valves, oil separators, service ports, liquid receivers and accumulators.

F. Sound: The sound pressure dB(A) at rated conditions shall be a value of 55-62 decibels at 3 feet from the front of a single condensing unit. The condensing unit shall be capable of operating at further 52-59 dB(A) in "quiet mode."

G. Restart: The condensing unit shall automatically restart operation after a power failure and shall not lose any settings during outage.

H. Layout: The condensing unit shall be modular in design and should allow for side-by-side installation with minimal spacing.

I. Safety Devices: Provide high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and anti-recycling timers. Provide sub-cooling feature. Oil recovery shall be automatic, occurring 1 hour after system start-up and after every 6 hours of operation after that, or as required to maintain oil levels at the condensing unit.

J. Condensing unit shall operate in heating mode to -4 degrees F dry bulb ambient without additional ambient controls.

K. Coils: Air-cooled heat exchange coils shall be copper tubing with aluminum fins. The coils will be set in a vertical formation with air being drawn in through three sides of the unit and discharged out the top of the unit.

L. Compressors: Condensing unit will have one inverter controlled hermetic twin rotary compressor and up to two high efficiency scroll compressors depending on type. Each compressor shall be equipped with a crankcase heater, high pressure safety switch and internal thermal overload protector.

M. Cabinet: Unit cabinet shall be completely weather proof and corrosion resistant.

N. Fan: Unit shall consist of two propeller type, direct drive fans that have multiple speed operation via a DC inverter. Fans shall have internal protection and permanently lubricated bearings.

O. Vibration: Unit shall have internal spring isolators.

2.10 HEATING DEFROST OPERATION

A. The system shall have the ability to use a continuous heating defrost operation for multi-module system configurations.

2.11 CHANGE-OVER BOXES

A. GENERAL

1. The change-over boxes shall be factory assembled, wired, piped and run tested at the factory.

2. Multiple indoor units may be connected to a port provided they are within the capacity range of the port.

B. VALVES

1. The unit shall be furnished with electronic expansion valves to control the direction of refrigerant flow in each branch. Use of solenoid valves shall not be acceptable due to noise.

C. CONDENSATE REMOVAL

1. Change-over Boxes shall not require provisions for condensate removal.

2.12 INDOOR UNIT – 4-WAY CASSETTE

A. GENERAL:

1. The unit shall have the ability to be recessed into the ceiling with a ceiling grill and shall be a 4-way air distribution type.

2. The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.

3. The unit and refrigerant pipes will be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.

4. The 4-way cassette shall be equipped with an electronic expansion valve.

5. All sizes of 4-Way Cassettes shall be equipped with a built-in condensate pump with 33.5" lift.

6. The unit shall have an automatic louver control.

7. The 4-way cassette shall be able to be configured for 2-way or 3-way airflow as well.

8. Provide units with wired in-room or remote temperature sensors as indicated on the drawings.

B. PERFORMANCE:

1. Each 4-way cassette's performance is based on nominal operating conditions shown in mechanical schedules.

C. UNIT CABINET:

1. The unit cabinet shall be space saving and have the ability to be recessed into a ceiling.

2. The 4-way panel shall be affixed to the bottom of the unit allowing for 4-way airflow.

3. The 4-way cassette (without panel) shall be no larger than 11-3/4" x 33-1/16" x 33-1/16" and weigh no more than 57 lbs.

4. An outside air knockout shall exist to for branch ducting supply air.

D. FAN:

1. Unit shall be equipped with a brushless DC fan motor drive.

2. The 4-way cassette shall consist of four fan speeds including: low (Lo), medium (Me), high (Hi), and high 2 (Hi2).

E. FILTER:

1. The standard 1" air filter shall be of a washable type.

F. SOUND:

1. The 4-way cassette sound pressure shall range 27 dB (A) to 37 dB (A) at low speed.

G. ELECTRICAL:

1. The unit shall be 208-230V, 1 phase, 60 Hertz.

2. The 4-way cassette shall have an acceptable voltage range of 187-255V.

3. The control circuit between the units in the system shall use AWG18-2 type control wire.

2.13 INDOOR UNIT – WALL MOUNT

A. GENERAL:

1. The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.

2. The unit and refrigerant pipes will be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.

3. The unit shall have an automatic wide angle louver control.

4. The unit shall have a removable front panel for easy cleaning.

5. The unit shall have an auto-swing function to ensure efficient air distribution and uniform temperature.

6. The unit shall have a built-in wireless sensor.

B. PERMORMANCE:

1. Each wall mounted indoor unit's performance is based on nominal operating conditions shown in the mechanical schedules.

C. UNIT CABINET:

1. The wall mount indoor unit shall be no larger than 13-1/8" x 45-9/32" x 9-21/32" and weigh no more than 37 lbs.

2. The unit shall be affixed to a separate galvanized steel back plate to secure the unit firmly to the wall.

D. FAN:

1. Unit shall be equipped with a brushless DC fan motor drive.

2. The wall mount shall consist of four fan speeds including: low (Lo), medium (Me), high (Hi), and high 2 (Hi2).

E. FILTER:

1. The standard 1" air filter shall be of a washable type.

F. SOUND:

1. The wall mount indoor unit sound pressure shall range 30 dB (A) to 41 dB (A) at low speed.

G. ELECTRICAL:

1. The unit shall be 208-230V, 1 phase, 60 Hertz.

2. The wall mount indoor unit shall have an acceptable voltage range of 187-255V.

3. The control circuit between the indoor units shall use AWG18-2 type control wire.

H. PIPING:

1. Refrigerant and drain piping shall have the ability to be connected at the right, left or rear of the unit for ease of installation.

2.14 INDOOR UNIT – DUCTED MEDIUM STATIC

A. GENERAL:

1. The ducted medium static indoor unit shall be a built-in ceiling type.

2. The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.

3. The unit and refrigerant pipes will be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.

4. All sizes of Ducted Medium Static units shall be equipped with a built-in condensate pump with 25" minimum drain lift.

5. The unit shall have bottom access for easy service and troubleshooting.

6. Provide units with wired in-room or remote temperature sensors as indicated on the drawings.

B. PERFORMANCE:

1. Each ducted medium static indoor unit's performance is based on nominal operating conditions shown in the mechanical schedules.

C. UNIT CABINET:

1. The cabinet shall be ceiling-concealed and ducted to the supply and return openings.

2. The ducted medium static indoor unit shall be no larger than 9-13/16" x 55-1/8" x 31-1/2" and weigh no more than 97 lbs.

D. FAN:

1. Unit shall be equipped with a brushless DC fan motor drive.

2. The ducted medium static indoor unit shall consist of four fan speeds including: low (Lo), medium (Me), high (Hi), and high 2 (Hi2).

E. FILTER:

1. Filter box with high efficiency filters shall be made available as an option.

F. SOUND:

1. The ducted medium static indoor unit sound pressure shall range 27 dB (A) to 34 dB (A) at low speed.

G. ELECTRICAL:

1. The unit shall be 208-230V, 1 phase, 60 Hertz.

2. The ducted medium static indoor unit shall have an acceptable voltage range of 187-255V.

3. The control circuit between the units in the system shall use AWG18-2 type control wire.

H. STATIC PRESSURE:

1. The ducted medium static indoor unit shall have adjustable static pressure up to .6 in WG.

2.15 INDOOR UNIT – DUCTED SLIM

A. GENERAL:

1. The ducted slim indoor unit shall be a built-in ceiling type.

2. The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.

3. The unit and refrigerant pipes will be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.

4. The unit shall have a bottom or horizontal return.

5. All sizes of Ducted Slim Units shall be equipped with a built-in condensate pump with 25" minimum drain lift.

6. The unit shall have bottom access for easy service and troubleshooting.

B. PERMORANCE:

1. Each ducted slim indoor unit's performance is based on nominal operating conditions shown in the mechanical schedules.

C. UNIT CABINET:

1. The cabinet shall be ceiling-concealed and ducted to the supply and return openings.

2. The ducted slim indoor unit shall be no larger than 7-9/16" x 46-3/8" x 17-19/32" and weigh no more than 57 lbs.

D. FAN:

1. Unit shall be equipped with a brushless DC fan motor drive.

2. The ducted medium static indoor unit shall consist of four fan speeds including: low (Lo), medium (Me), high (Hi), and high 2 (Hi2).

E. FILTER:

1. Filter box with high efficiency filters shall be made available as an option.

F. SOUND:

1. The ducted slim indoor unit sound pressure shall range 27 dB (A) to 34 dB (A) at low speed.

G. ELECTRICAL:

1. The unit shall be 208-230V, 1 phase, 60 Hertz.

2. The ducted slim indoor unit shall have an acceptable voltage range of 187-255V.

3. The control circuit between the units in the system shall use AWG18-2 type control wire.

H. STATIC PRESSURE:

1. The ducted medium static indoor unit shall have adjustable static pressure up to .20 in WG.

2.16 CONTROLLERS

A. Wired Zone Controllers:

1. Backlit display

2. Built-in thermistor

3. Standard wall controller
4. Controls temperature, mode, fan speed
5. Seven-day timer with multiple setpoints
6. Controls up to 16 indoor units
7. Built-in 23-hour timer
8. Room name and service company name programmable
9. Help menus and error code diagnosis
10. Large LCD display permits users to see the operating conditions and settings
11. The timer can be set at half-hour intervals
12. Monitors the operating conditions in the system, and an alarm is issued if a problem occurs.
13. A "self-diagnosis function" checks for problems on:
    a. printed boards in indoor and
    b. outdoor units
14. Temperature range limit
15. Individual function lockout. (mode, temperature, fan speed)

B. CENTRAL CONTROLLERS

1. Controls up to 64 groups of indoor units (maximum 160 units)
2. Easy-to-use touchscreen interface
3. Color-coded graphics for quick reference
4. Set up to 10 on/off times per day
5. Up to 8 Large Controllers can be connected
6. External input/output terminals are provided as standard. External signals enable the following options:
    a. Central operation/stop

b. Demand control

c. Emergency stop

1) Central operation output

2) Central alarm output

7. Control Functions

8. Run/Stop

C. VRF CENTRAL CONTROLLERS

1. Controls up to 2048 groups of indoor units with adapter (maximum 2560 units)

2. Intuitive, large touchscreen

3. Individual zone control with weekly programmable schedule

4. Basic central point on/off control of all units

5. Advanced multi-zone control of large commercial projects

6. Automatic cooling/heating changeover for heat recovery systems

7. Single input batch shutdown of all connected units

8. Multiple tenant power billing for shared condenser applications

9. Graphical user interface with floor plan layout

D. VRF SMART GATEWAY

1. Supports up to 64 VRF systems, up to 160 Indoor Units, and up to 200 total Indoor and Outdoor Units

2. Integrates with the building automation systems

3. Integrates with third party building automation systems supporting the BACnet IP protocol

4. BACnet Gateway (B-GW) device profile

5. BACnet IP, (Annex J), BACnet Broadcast Management Device (BBMD)"

6. Connects up to 4 Central Controllers simultaneously

7. Includes a Wi-Fi antenna for access via Laptop, Smartphone, etc.

PART 3 - EXECUTION

3.1 VARIABLE REFRIGERANT VOLUME SYSTEM INSTALLATION

A. General: Install system components where indicated on the drawings in accordance with equipment manufacturer's published installation Instructions.

B. Access: Provide access space around system components for service as indicated on the drawings, but in no case less than that recommended by the manufacturer.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but specified to be factory-mounted. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections.

D. Refrigerant Piping: Provide field installed refrigerant piping in accordance with Division-23 section, "Refrigerant Piping."

E. Piping Connections: Provide piping, valves, accessories, gauges, supports, and flexible connections as indicated on the drawings. Provide ball valves at each indoor unit for ease of system isolation.

3.2 START-UP

A. General: Start and adjust all units installed under this specification under the supervision of an authorized factory trained representative of the manufacturer of each unit. Perform operational checks to make certain that controls and safety devices and systems are operating properly. If defects or improper adjustments are found, they shall be corrected and tests repeated.

1. An operational check shall be made to demonstrate compliance with contract requirements, including but not limited to, capacity and control accuracy.

2. A report, signed by each factory representative, shall be submitted showing test conditions and results.

END OF SECTION

SECTION 23 8200 - HEATING AND COOLING TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of terminal unit work is indicated by drawings and schedules, and by requirements of this section and all other Division-23 sections.

B. Types of terminal units required for project include the following:

1. Electric Duct Heating Coils
2. Recessed Electric Wall Heaters
3. Electric Unit heaters

C. Refer to requirements of Division-26.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. I=B=R Compliance: Test and rate finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem of I=B=R.
2. ARI Compliance: Provide coil ratings in accordance with ARI Standard 410 "Forced Circulation Air-Cooling and Air-Heating Coils".
3. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".
4. ARI Compliance: Test and rate fan coil units in accordance with ARI Standard 440 "Room Fan Coil Air-Conditioners".
5. UL Compliance: Construct and install fan coil units in compliance with UL 883 "Safety Standards for Fan Coil Units and Room Fan Heater Units".
6. ARI Compliance: Test and rate unit ventilators in accordance with ARI Standard 330 "Unit Ventilators".

7. UL Compliance: Provide electrical components for terminal units which have been listed and labeled by UL.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.

B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units, and moving them to final location.

PART 2 - PRODUCTS

2.1 ELECTRIC DUCT HEATING COILS

A. General: Provide electric duct heating coils with automatic reset thermal cutouts for primary over temperature protection and with load carrying manual reset thermal cutouts, factory wired in series with each heater stage, for secondary protection. Include overcurrent cutouts and sub-circuit fusing in assembly and construct with the following additional

construction features:

1. Finned Tubular Electric Coils: Construct coils with resistance wire of 80% nickel/20% chromium, mounted in copper plated steel tube and surrounded by compacted magnesium-oxide powder. Provide spiral wound copper plated steel fins brazed continuously to tubes.

2. Heating Capacity: Size coils based in the ratings of the required output (Btuh), electrical input (watts, voltage, phase) and CFM.

3. Casing Assembly: Slip-in type.

4. Casing Material: Galvanized steel coil casing.

5. Casing Material: Aluminized steel coil casing.

2.2 RECESSED ELECTRIC WALL HEATERS

A. General: The heating equipment shall include an electric automatic fan forced air heater suitable for small area heating as manufactured by QMark or approved equal. The heater shall be designed for recessed wall mounting. Heaters shall be UL listed or equivalent (ETL).

B. Backbox: The backbox shall be designed for duty as a recessed rough-in box in either masonry or frame installations. The backbox shall be heavy gauge galvanized steel and shall contain knockouts through which power leads are brought.

C. Inner Frame Assembly: The heater assembly which fits into the backbox shall consist of a heavy gauge steel fan panel upon which is mounted all of the operational parts of the heater. The inner frame assembly shall be completely pre-wired.

D. Heating Element: The heating element shall be of the non-glowing design consisting of an 80/20 nickel-chromium resistance wire enclosed in a steel sheath to which plate fins are copper brazed. It shall be warranted for 5 years. The element shall cover the entire air discharge area to ensure uniform heating of all discharge air.

E. Power On/Off Switch: A double-pole single throw ON/OFF switch shall be mounted on the back box for positive disconnect of power supply. It will be completely concealed behind the front cover.

F. Motor and Controls: The fan motor shall be impedance protected, permanently lubricated and with totally enclosed rotor. Fan control shall be of the bi-metallic, snapaction type and shall activate fan after heating

element reaches operating temperature, and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. The thermostat shall be single pole type on all models. Manual-reset thermal cutout shall be bi-metallic, snapaction type designed to shut off heat in the event of overheating. The fan shall be four-bladed aluminum.

G. Surface Mounting Frame: The surface mounting frame shall be of heavy gauge steel designed to mount around the backbox for a finished surface installation. Slot knock outs shall be provided for power supply conduit.

H. Front Cover: The louvered front cover shall be of heavy gauge steel with a polyester powder coat finish. A plug button will be provided to replace the thermostat knob and render the unit tamper-resistant.

I. Finish: All sheet metal parts, except the galvanized steel backbox, shall be phosphatized, then completely painted by a powder paint process.

2.3 ELECTRIC UNIT HEATERS

A. General: Provide unit heaters where indicated, of sizes and capacities as scheduled. All units shall be UL listed.

B. Cabinets: The cabinet shall be constructed from 18 gauge (1.3 mm) die formed, furniture grade steel.

1. Individually adjustable louvers with 30 degree downward stops shall be furnished.

2. All metal surfaces of the casing shall be phosphate coated to resist corrosion and finished with baked enamel.

3. Provide mounting brackets as required.

C. Elements: The electric heating bank shall consist of metal sheath heating elements. The elements shall have a copper clad steel sheath and aluminum fins.

D. Motors and Fans: Motors shall be totally enclosed, continuous heavy duty all-angle operation, equipped with built-in thermal overload protection. Fans shall be aluminum, directly connected to fan motor, designed specifically for unit heater application.

E. Controls: Automatic reset thermal overheat protector shall be of the linear capillary type, wired for instantaneous de-energizing in case of thermal

overload.

1. Fans shall be complete with delay feature to eliminate cold draft. Element shall heat-up before fan energizes, then fan continues to distribute heat after element shuts off.

2. Provide a low voltage control transformer for remote wall mounted thermostat and summer fan switch.

F. Provide with power disconnect switch.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CONVECTORS

A. General: Install convectors as indicated, and in accordance with manufacturer's installation instructions.

B. Locate convectors as indicated, coordinate with other trades to assure correct recess size for recessed convectors.

3.3 INSTALLATION OF UNIT HEATERS

A. General: Install unit heaters as indicated, and in accordance with manufacturer's installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang units from building substrate. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.

D. Support units with rod-type hangers anchored to building substrate.

E. Protect units with protective covers during balance of construction.

3.4 INSTALLATION OF CABINET HEATERS

A. General: Install cabinet heaters as indicated, and in accordance with manufacturer's installation instructions.

B. Locate cabinet heaters as indicated, coordinate with other trades to assure correct recess size for recessed units.

C. Protect units with protective covers during balance of construction.

3.5 INSTALLATION OF FAN COIL UNITS

A. General: Install fan coil units as indicated, and in accordance with manufacturer's installation instructions.

B. Locate fan coil units as indicated, coordinate with other trades to assure correct recess size for recessed units.

C. Protect units with protective covers during balance of construction.

3.6 INSTALLATION OF UNIT VENTILATORS

A. General: Install unit ventilators as indicated, and in accordance with manufacturer's installation instructions.

B. Locate unit ventilators as indicated, level and shim units, anchor to substrate. Coordinate with other trades for exact location of wall louvers.

C. Protect units with protective covers during balance of construction.

D. Install shelving and auxiliary radiation, Provide wall trim pieces for continuous wall-to-wall installation.

3.7 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.8 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

3.9 EXTRA STOCK

A. Filters: Furnish one (1) extra set of filters for each terminal unit to the owner. In addition, install new filters at completion of terminal unit work, and prior to testing, adjusting, and balancing work. Do not operate fans unless filters are in place.

B. Belts: Contractor shall furnish one (1) spare set of belts for distinct terminal unit size. Deliver to the Owner's representative and mark with the terminal unit size.

END OF SECTION

SECTION 23 8300 - RADIANT FLOOR HEATING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide a hot water radiant floor heating system of the size, capacity, material, and configuration where and as denoted on the drawings and herein specified. System furnishings and installation shall conform to guidelines outlined herein.

B. Types of radiant floor heating installations:

1. Concrete Slab - Tubing shall be installed in a concrete pad with a minimum 4" thickness. Tubing shall have a minimum concrete coverage of 2" on top of the tubing, this top cover depth shall minimize aggregate appearance and surface cracking. When noted on installation drawings the slab shall be poured on top of rigid foil-faced insulation (foil side up) and/or a vapor barrier material. Tubing shall be secured in place by fastening the tubing to the concrete rebar or rewire, by plastic zip ties. Tubing shall be secured in place to minimize movement during material pour.

1.2 QUALITY ASSURANCE

A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.

B. System components shall be UL listed.

C. Ensure equipment pressure ratings are at least equal to system's maximum operating pressure at point where installed, but not less than specified.

D. Equipment manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment with a minimum of ten (10) years' experience.

E. Equipment provider shall be responsible for providing equipment start-up and, when noted, an in the field certified training session. New equipment start-up shall be for the purpose of inspecting equipment installation manner and control system start-up. A copy of the start-up report shall be

made and sent to both the contractor and to the Engineer.

1.3 PRODUCT HANDLING

A. Protection: Use all means necessary to protect equipment before, during, and after installation.

B. Replacement and Repair: All scratched, dented, and otherwise damaged units shall be repaired or replaced as directed by the Architect/Engineer.

1.4 REGULATORY REQUIREMENTS

A. Conform to International Mechanical Code

B. Conform to International Building Code

C. Conform to International Fire Protection Code

D. Conform to National Electric Code NFPA 70

E. Conform to Illinois Accessibility Code

F. Conform to applicable ANSI standards

G. Conform to American Standard Testing Method standards for product testing

H. Conform to Radiant Panel Association installation standards

I. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.5 SUBMITTAL

A. Submit each item in this article according to the Conditions of the Contract and Division-01 Specification Sections.

B. Submit manufacturer's installation instructions under provisions of General Conditions and Division-01.

C. Submit product data including dimensions, temperature capacities (both constant and intermittent), pressure ratings (both operating and burst), material composition, design criteria (including: heat loss calculations, lengths, design flows, pressure drops, and bend radius), furnished

specialties, controls, and accessories.

D. Submit control providers sequence of operation for the radiant heating system operation, if not previously described in the temperature controls division of the specification. Control sequence of operation shall be provided to outline the system's overall design sequence. The written sequence of operation shall include description of operation and logic, along with a piping and wiring schematic.

E. Tubing installation, layout, and maintenance data requirements should follow the recommendations in the manufacturer's installation instructions.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit Operation and Maintenance information under provisions of Division-23 and the provisions of the General Conditions and Division-01.

B. Operation and Maintenance Data: Include installation instructions.

C. Under provisions of commissioning documentation; testing of equipment, as well as training of owner's operation and maintenance personnel may be required in cooperation with the commissioning consultant.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site in such a matter as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Materials damaged by the elements should be packaged in such a matter that they could withstand short-term exposure to the elements during transportation.

B. Store materials in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.

C. Radiant tubing material shall be capable of withstanding exposure to direct sunlight without degradation for a period of at least 30 days prior to installation.

D. Radiant tubing material shall be capable of being installed directly on conventional base rock or sand fill material. Tubing shall regain its original shape naturally after any kinking with the use of applied heat or physical repair.

1.8 WARRANTY

A. Provide the tubing with a minimum 25 year non-prorated commercial warranty under provision of Division-23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design is radiant floor heating system is by Rehau. The radiant floor heating system shall be furnished, installed, commissioned and warranted by one of the following acceptable manufacturers:

1. Rehau
2. Watts Radiant
3. Wirsbo
4. Stadler

2.2 RADIANT SYSTEM MATERIALS

A. Tubing:

1. Contractor shall furnish and install a new hydronic radiant heating system as indicated on the drawings. PEX tubing materials and trim shall be utilized. Tubing shall be UV-resistant, so as not to degrade when exposed to continuous sunlight. Tubing shall be rated for continuous working pressures of 100 PSI at 180°F and 80 PSI at 200°F.
2. All radiant heating and/or cooling pipe shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876 and CSA B137.5.
3. Tubing shall be UL listed to 180°F and shall remain flexible at temperatures down to 50°F.
4. Bend Radius
    a. The minimum bend radius for cold bending of the pipe shall be not less than five (5) times the outside diameter.

b. Bends with a radius less than this shall require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

5. Compliant Standards – ANSI/UL 263 through certification listings with Underwriters Laboratories, Inc. (UL).

6. Pipe to have a Flame Spread Index and a Smoke Developed Index listing to ASTM E84 (in U.S.) or CAN/ULC S102.2 (in Canada). This listing may require the pipe to be installed in a rated insulation material or an approved steel support channel.

7. Manufacturer shall provide complete design information at time of bid. Tubing layout shall be based on using multiple equal length tubes off of the same manifold.

8. Tubing installation style, layout, and affixing method shall be as shown on installation drawings, or as approved by the architect/engineer.

B. Fittings

1. Fittings shall be third-party certified to applicable standards ASTM F877, ASTM F2080 and CSA B137.5, with independent listings from NSF and/or CSA as applicable.

2. Compression nut manifold fittings shall be manufactured of brass with a barbed insert and a split compression ring.

3. Compression-sleeve fittings shall be manufactured of brass and shall be approved by the piping manufacturer to be part of a proven cataloged system.

4. Fittings embedded within the thermal mass shall be cold-expansion compression-sleeve fittings certified to ASTM F2080. Where required by the manufacturer, fittings shall be protected from external environmental conditions.

C. Manifolds:

1. The radiant tubing manufacturer shall provide manifolds of the correct size and number as noted on plans and installation drawings. Manifolds shall be sized to handle the specified flow capacity of the area it serves and shall be sized adequately to not create localized velocity noises.

2. Material: Distribution manifolds shall be manufactured of brass,

copper or stainless steel and be supplied by the piping manufacturer as a proven cataloged part of the manufacturer's system.

3. Brass manifolds shall be produced from extruded brass round pipe with tapped holes for connections, and be pre-assembled by the manufacturer. 100% of manifolds used shall have been air tested by the manufacturer with no indication of leaks.

4. Balancing Manifolds

   a. Where required by design, brass balancing manifolds shall be equipped with integral visual flow gauges, circuit balancing and flow control valves, isolation valves with integral thermometer housings, and air vent/fill ports.

   b. Each circuit valve shall be supplied with a manual actuating handle for filling/purging operation.

5. Copper Manifolds

   a. Copper manifolds shall be manufactured from Type L copper.

   b. Copper and/or brass outlets shall be high-temperature brazed (lead-free) into headers.

   c. Outlets in copper headers shall be made using the T-drill process according to ASTM F2014.

6. During start-up each manifold set shall be connected to a pressure test kit for field verified testing and system fill/purging.

D. Accessories:

1. Radiant tubing manufacturer shall provide additional installation components necessary to facilitate the radiant tubing installation including but not limited to:

   a. An adequate number of field repair kits

   b. Cable ties

   c. Staple gun and staples

   d. Manifold mounting brackets

   e. Pressure test kit

f. Hose unwinder

2.3 RADIANT HEAT TRANSFER PACKAGE

A. General:

1. The package shall include all of the controls, pumping equipment, air elimination devices, control devices required to provide a complete system.

2. The package shall be provided by the tubing provider and shall be a modular panel mounted design. The package shall come completely wired for single point connection and piped for easy field installation including all necessary piping and electric schematics, and a written sequence of operation.

3. Package shall be completed to the point that in the field only:

a. Supply and return lines to and from the heat source must be piped and connected.

b. Supply and return lines to and from each zone manifold set must be piped and connected.

c. Supply power must be wired into the package,

d. Remote Room Thermostat Units (RTU) must be installed, as shown on plans and installation drawings, and wired back to the package.

e. An outdoor sensor, as shown on plans and installation drawings, must be mounted and wired back to the controller.

B. Radiant Heating Control System:

1. Room thermostats shall be low-voltage devices with electronic temperature sensing, and shall be supplied by the pipe manufacturer as part of a proven cataloged system.

2. Circuit actuators shall be low-voltage thermo-electric design for actuation of valves on manifold with visual indication of position, and built-in end switches, and shall be supplied by the pipe manufacturer as part of a proven catalogued system.

3. Provide system with floor temperature sensor to limit floor slab from overheating.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall coordinate the entire radiant system installation with the system equipment provider. All components shall be installed in accordance with manufacturer's installation instructions.

B. Examine areas and conditions under which radiant equipment is to be installed, and substrate, which will support tubing. Do not proceed with work until satisfactory conditions have been corrected in a manner acceptable to the installer, architect/engineer, and/or owner.

C. Proper access space around a device should be left for servicing the component. No less than the minimum recommended by the manufacturer.

D. Provide an adequate number of isolation valves for service and maintenance of the system and its components.

E. Provide temperature and pressure gauges where and as detailed or directed.

F. Pumps shall have sufficient capacity to circulate the scheduled GPM against the scheduled external head (feet) with the horsepower and speed as scheduled and/or as denoted on the drawings. Motors shall be of electrical characteristics as scheduled, denoted and/or as indicated on the electrical plans and specifications. Pump characteristics shall be such that the head of the pump under varying conditions shall not exceed the rated horsepower of the drive motor.

G. All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping. All piping shall be fitted to the equipment even though piping adjustments may be required after the pipe is installed.

H. Provide drains for relief valves and package drains. Relief valves shall be piped to and discharging into floor drains. Package drains need not be hard piped to drain, but shall have reasonable access to a floor drain for system drainage.

I. Manufacturer's representative shall instruct the maintenance personnel in the care of the equipment.

J. Provide start-up reports outlining factory provided start-up and

equipment performance.

3.2 INSTALLATION

A. Radiant tubing shall be installed in the manner outlined on plans and installation drawings, and per the manufacturer's recommended installation drawings. Tubing shall be located in walls, concrete, or in sand-base.

B. Radiant tubing shall be provided as precut units of set lengths; the lengths shall be based on the system design criteria. Each length of tubing shall be connected to the manifold set; each length of tubing connected to a given manifold set shall be of equal length. The provided tubing should not be cut in the field, unless an equal amount of tubing is removed from each tube connected to the manifold set.

C. Tubing shall be installed continuously throughout the entire radiant area. Tubing shall be installed at specified spacing (regular spacing and banded area spacing), unless otherwise indicated. Special tubing spacing, "banded areas", are tubing areas were the tubing spacing is to be installed tighter than in the other areas. Typical banded areas are areas that intersect outside wall and high heat loss areas.

D. Tubing should be affixed to the bard fittings on the manifolds and held in place via tension clamps.

E. Upon completion of the tubing installation, contractor should pressure test the tubing system before filling the system with water before proceeding with covering of the tubing system. Each manifold set shall be isolated from the main system and the tubing connected to that manifold set shall be pressure tested under 100 PSI air pressure per manufacturer's recommended installation instructions. Test pressure shall be held for a minimum of 24 hours and a maximum of 72 hours. Any substantial loss of air pressure denotes a system leak that must be located and repaired. After system repair pressure test should be repeated.

F. After a successful pressure test the tubing system can be covered. When encapsulating tubing in concrete or working in proximity to the tubing the system should be placed under either water or air pressure. Working around the tubing with it under pressure will noticeably alert installers if the tubing has been damaged during construction. Construction around the tubing can then be stopped until the tubing is repaired. Pressurizing the system with air will create a less catastrophic effect if the tubing is damaged then water, but the duration that a system is under air pressure should be limited. Prolonged exposure to air pressure may allow some air to be absorbed into the inner tubing layer and cause start-up nuisances.

G. Manufacturer's agent shall work with contractor to insure a correct installation. Manufacturer's agent shall spend a minimum of two 8-hour days of instruction with the contractor at the site.

3.3 FIELD QUALITY CONTROL

A. Flush and clean system piping upon completion of installation, in accordance with manufacturer's start-up instructions.

B. Hydrostatically test system including radiant tubing system, interconnecting piping, and pumping and control package prior to pouring the floor slab.

C. Start-up system, in accordance with manufacturer's start-up instructions, and in presence of equipment manufacturer's representative. Test controls and demonstrate compliance with requirements of these Division-23 specifications.

3.4 CLOSEOUT PROCEDURE

A. When required, provide services of manufacturer's technical representative for one 4-hour day to instruct Owner's personnel in operation and maintenance of the radiant floor heating system.

1. Schedule training with Owner, provide at least a 7-day notice to Contractor and Engineer of training date.

END OF SECTION

SECTION 26 0100 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. Unless otherwise modified, provisions of General Conditions, Supplementary Conditions and Division-01 govern work under the Electrical Divisions.

B. The drawings and specifications shall be followed in layout of work.

C. The Architectural drawings shall be used for all dimensional information. Do not scale from the Electrical drawings.

D. Contract Document Interpretation/Discrepancies:

1. Should the Contractor discover any discrepancies or omissions on the drawings or in the specifications, he shall notify the Architect/Engineer (A/E) of such conditions prior to the bid date. Otherwise, it will be understood that the drawings and specifications are clear as to what is intended and shall be as interpreted by the A/E.

2. In addition, should any contradiction, ambiguity, inconsistency, discrepancy or conflict appear in or between any of the Contract Documents, the Contractor, shall, before proceeding with the work in question, notify the A/E and request an interpretation. In no case shall he proceed with the affected work until advised by the A/E.

3. If the Contractor fails to make a request for interpretation of discrepancies or conflicts in the drawings or specifications, no excuse will be accepted for failure to carry out the work in a satisfactory manner, as interpreted by the A/E. In all cases, the Contractor will be deemed to have estimated the most stringent materials and methods (i.e. the highest quality materials and most expensive manner of completing the work) unless he has requested and obtained written authorization as to which methods or materials will be required.

4. Each and every trade or subcontractor will be deemed to have familiarized himself with all drawings of this project, including Site/Civil, Architectural, Structural, Mechanical, Electrical, Information Technology, etc. so as to avoid coordination errors,

omissions, and misinterpretations. No additional compensation will be authorized for alleged errors, omissions, and misinterpretation, whether they are a result of failure to observe these requirements or not.

E. The complete set of Architectural, Structural, Civil, Mechanical, Plumbing, and Electrical drawings, specifications, and addenda apply to this work.

1.2 DESCRIPTION

A. Unless otherwise modified in other Sections, or on the contract drawings, which define the scope and arrangement of the electrical work to be provided, the applicable provisions of these General Requirements shall govern the furnishing of all supervision, labor, equipment, tools, services, and materials necessary to install a complete electrical system ready for continuous and successful operation. The work shall include, but not be limited to, the furnishing and installation of the following items, as applicable:

1. Electrical services, including metering facilities, meeting the requirements of and in coordination with the local electric power company. Refer to the latest edition of the local power company manuals for service details.

2. Power and lighting panelboards, and all required overcurrent devices.

3. Power feeders, branch circuit wiring and disconnect switches for mechanical equipment.

4. Lighting and receptacle feeders and branch circuit wiring.

5. Lighting fixtures with lamps.

6. Exit and emergency lighting.

7. Fire alarm system.

8. Telephone services and associated systems, including raceways and outlets, meeting the requirements of and in coordination with the local telephone company.

9. Computer Management Information, Intercommunication, Sound, Video Cable, Master Antenna, Master Clock and Program, Security, Lightning Protection and Emergency Power Systems, including raceways, wiring and outlets, meeting the requirements of and

coordination with the associated companies and the applicable sections of these specifications.

B. Provide seals for all openings through smoke and fire-rated walls, floors, or ceilings used as passage for electrical conduits, cables, and cable trays per the smoke and fire stopping requirements in this section. This applies to both new and existing penetrations.

1.3 PERMITS, INSPECTION AND CERTIFICATION

A. Permits: Refer to the General Conditions of the Contract.

B. Inspections:

1. Refer to the latest edition of the local power company manuals for service inspection requirements.

2. See submittal requirements section of this specification section for additional work related to the inspection documentation needed for all underground work.

C. Certifications:

1. Certificates of final inspection and approval required by agencies or authorities having jurisdiction shall cover all electrical work.

2. All certificates of final inspection and approval shall be delivered to the Engineer prior to final acceptance of the electrical work.

1.4 CODES, STANDARDS AND REFERENCES

A. The electrical work covered under the specifications and drawings shall be performed in strict accordance with the latest adopted edition of the following codes and standards:

1. National Electrical Code (NEC), NFPA 70

2. Applicable codes and standards of the National Fire Protection Association (NFPA)

3. National Electrical Safety Code, ANSI C2

4. International Building Code (IBC)

5. All authorities having jurisdiction

B. The work covered under the specifications and drawings shall be performed using the following references as minimum standards for construction and testing:

1. American National Standard Institute (ANSI)
2. National Electrical Manufacturers' Association (NEMA)
3. Underwriter's Laboratories (UL)
4. The Occupational Safety and Health Act (OSHA)
5. InterNational Electrical Testing Association (NETA)
6. Applicable standards of the utility company and the telephone company
7. American Society of Testing Materials (ASTM)
8. Institute of Electrical and Electronic Engineers (IEEE)
9. Illuminating Engineering Society (IES)
10. Insulated Cable Engineers Association (ICEA)
11. Lightning Protection Institute (LPI)

C. Electrical construction materials shall, where a listing is normal for the particular class of material, be listed in "Electrical Construction Material List" of the Underwriter's Laboratories, Inc. (UL) and shall bear the listing label. Electrical equipment shall, where a listing is normal for the particular class of equipment, be listed in the "Electrical Appliance and Utilization Equipment List" of the Underwriter's Laboratories, Inc. (UL) and shall bear the listing label. Materials and equipment listed and labeled as "approved for the purpose" by a Nationally Recognized Testing Laboratory (NRTL), inspection agency or approved organization shall be acceptable.

1.5 CLARIFICATION OF DRAWINGS

A. Should a bidder find discrepancies in or omissions from the drawings or specifications, or should he be in doubt in regard to their intent, the Contractor shall notify the Engineer before submitting bid proposal. The Engineer shall then send written instructions to all bidders.

1.6 SUBMITTALS, REVIEW AND ACCEPTANCE

A. Complete shop drawings and material lists shall be submitted by the Contractor for review by the Engineer in accordance with the requirements of the GENERAL PROVISIONS. Equipment and materials for which shop drawings are not submitted shall be provided as specified, and other manufacturers and products will not be allowed. No work shall be fabricated or ordered by the Contractor until approval has been given by the Engineer.

B. Complete shop drawings showing dimensions, materials, arrangements, and other pertinent data shall be submitted.

C. Complete lists of materials and equipment shall be submitted. Full description catalog or other data shall be submitted.

D. Shop drawings and material lists shall be submitted for, but not limited to the following:

1. Conduit
2. Wire
3. Boxes, Fittings, and Wire Troughs
4. Cabinets
5. Wiring Devices
6. Panelboards
7. Dry-Type Transformers
8. Safety Switches
9. Low Voltage Fuses
10. Enclosed Circuit Breakers
11. Lighting Fixtures and Components
12. Lighting Control Equipment
13. Metering Equipment
14. Surface Metal Raceways
15. Multi-Outlet Assemblies

16. Floor Boxes

17. Motor Starters

18. Remote Control Switches

19. Automatic Transfer Switches

20. Emergency Generator

21. Emergency Lighting Equipment

22. As elsewhere indicated on the drawings or in the specifications.

E. Submit a photographic record of all underground installations, captured prior to concealment. Present adequate quantity and perspectives to convey the entire installation and its compliance with the contract drawings and specifications. Failure to submit a meaningful record may result in a further requirement to excavate portions for review and inspection, at the request of the owner or A/E team, at no additional cost.

F. Submittals shall include but not be limited to the following information: Size, type, functional characteristics, compliance with standards, required service access which shall be suitable for intended location and use, electrical service connections and requirements, and deviations from Contract Document requirements.

G. Shop drawings shall include plans, elevations, sections, mounting details of component parts, point to point interconnection diagrams, elementary diagrams, single line diagrams, and any other drawings necessary to show the fabrication and connection of the complete item or system.

H. Submit shop drawings and/or diagrams for all specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings or where the proposed installation differs from that shown on the contract drawings.

I. Submittals shall include Riser Diagrams and Schematic Wiring Diagrams, complete conduit and wire requirements, outlet and junction box sizes and power requirements, for the following systems:

1. Grounding Systems

2. Fire Alarm Systems

3. Security Systems

4. Telephone System

5. LAN and Computer/Data Transmission Systems

6. As indicated elsewhere on the drawings or specifications.

J. Submit 1/4" (6 mm) or 1/2" (13 mm) scale plans showing layout of equipment in electrical and communication equipment rooms and closets, elevator machine rooms, etc., indicating sizes of equipment, dimensions, clearances, etc. based on equipment being installed.

K. Prepare and stamp each submittal in a form indicating that the documents have been contractor reviewed, are complete and are in compliance with the requirements of these contract drawings and specifications.

L. In general, catalog cuts, specification sheets, descriptive data, etc., shall be acceptable for submittal of all equipment specified by standard catalog numbers, unless otherwise noted in the construction documents.

M. Shop drawings shall be clearly legible; poor reproductions or reduced photographic copies that are not legible shall be rejected.

N. Before submission of shop drawings the Contractor shall carefully check same for proper capacity, operating characteristics, physical arrangement accessories, etc., as specified or noted on drawings. If shop drawings are submitted and indicate little or no prior checking by the Contractor, they shall be rejected.

O. Submittal Identifications:

1. Place a permanent label or title block on each submittal for identification.

2. Indicate name of firm or entity that prepared each submittal on label or title block.

3. Provide a space approximately 4 by 5 inches on label or beside title block to record contractor's review and approval markings and action taken by A/E.

4. Include the following information on label for processing and recording action taken:

a. Project name

b. Date

c. Name and address of A/E

d. Name and address of contractor

e. Name and address of subcontractor

f. Name and address of supplier

g. Name of manufacturer

h. Unique identifier, including revision number

i. Number and title of appropriate specification section

j. Drawing number and detail references, as appropriate

k. Other necessary identification

l. Example: 262416-01-0

1) 262416 references the spec section

2) 01 indicates this is the first submittal from this spec section

3) 0 indicates this is the original submittal (where 1 would indicate this is the first re-submittal)

P. Submittals not in compliance with the requirements of this section will be returned without review.

Q. Submittals will be checked only for general conformance with the design concept and are subject to the original contract documents, as well as any corrections and comments noted. Comments noted, if any, will not be considered a complete list of all omissions, deviations and corrections necessary to meet the requirements of the contract documents. The contractor will be responsible to confirm that the final product and installation will be in conformance with the contract documents in their entirety, including the responsibility to fully coordinate all work with other trades and to confirm the correctness of dimensions, quantities, and capacities. Submittal review does not authorize or constitute a change to the contract requirements and does not release the contractor of responsibility to conform to the contract requirements. Requirements of the contract are not waived by review of any and all substitutions. The contractor must fulfill the terms of the contract.

R. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish the named item, or equivalent, subject to acceptance. Suitability of only the named item has been

verified. Where more than one item is named, only the first named item has been verified as suitable.

S. Substituted items or items other than first named shall be equal or better in quality and performance and must be suitable for the available space, required arrangement, application and clearances. Submit any and all data necessary to determine the suitability of substituted items. Substitutions must be submitted for consideration seven (7) days prior to the original bid date. Consideration of substitutions shall be at the sole discretion of the Engineer. Substitution submittals shall include all information required in the "Submittals" sub-section of this specification section, as well as all other requirements indicated throughout the Division-26 specifications. All changes incurred as a result of a substitution shall be provided at no additional cost to the Owner.

T. Substitutions will not be permitted for specific items of material or equipment where specifically noted.

U. Compliance Review Form: Each equipment submittal must include a Compliance Review Form formatted as follows:

1. Section 1: Certify that the submittal is in complete compliance with the plans and specifications, except for the numbered and footnoted deviations and exceptions as defined herein. Deviations or exceptions taken in a cover letter or by contradiction or omission shall not constitute a release from the requirement that the equipment be in complete compliance with the plans and specifications.

2. Section 2: Provide a detailed paragraph by paragraph annotation of the specification with an individual "C", "D", or "E" noted in the margin, as follows:

    a. "C" shall mean compliance with no exceptions. Provide a numbered footnote (i.e. C1, C2, C3, etc.) for each comment or clarification.

    b. "D" shall mean compliance with deviations. For each deviation, provide a numbered footnote (i.e. D1, D2, D3, etc.) with a detailed explanation of how the intent of this specification is to be satisfied.

    c. "E" shall mean exception. The equipment offered is not in compliance with the specifications. For each exception, provide a numbered footnote (i.e. E1, E2, E3, etc.) with a detailed description of the exception.

V. Electronic Submittals: Should the contractor elect to submit electronic shop drawings/submittals, the procedure shall be as follows:

1. Provide a transmittal with the electronic shop drawing/submittal indicating that the document was transmitted electronically. Transmittal shall also include verification of the contractor's review indicating compliance with the contract documents.

2. Sequentially number all pages on the electronic shop drawing/submittal. The total number of pages shall be reflected in the transmittal.

3. Submittal review comments shall be transmitted electronically. Large documents will be scanned with comments as necessary and returned electronically.

4. All shop drawings such as, but not limited to: coordination drawings, ductwork shop drawings, fire alarm drawings, ductbank layouts, etc. shall be submitted in hard copy, full size format.

5. Provide hard copy of the shop drawing/submittal for each of the Operations and Maintenance Manuals.

6. Failure to comply with the above will result in the submittal being returned and marked "Not Reviewed".

W. The engineer will provide a maximum of two (2) submittal reviews per equipment submittal; the initial review plus one (1) re-submittal. Should the re-submittal be returned "Not Acceptable" or "Revise and Resubmit", the contractor shall choose one of the following courses of action:

1. Provide the exact manufacturer and model indicated in the contract documents as the basis of design, or

2. Reimburse the engineer for all additional review time required to achieve a submittal review from the engineer of "No Exceptions Taken."

3. Should the contractor choose option 2 above, the engineer shall be reimbursed at an hourly rate of $175 per hour with payment due prior to the return of the final submittal. In addition, the contractor shall accept complete responsibility for all delays resulting from the submittal review process extending beyond two (2) reviews per equipment submittal.

X. Resubmittals: Resubmittals shall comply with paragraph 1.06 of this section and the following additional requirements.

1. Resubmittals shall include a written response to each submittal comment. Provide a detailed comment by comment annotation of the submittal review comments with an individual "C", "D", or "E" as follows:

   a. "C" shall mean compliance with no exceptions. Provide a numbered footnote (i.e. C1, C2, C3, etc.) for each comment or clarification.

   b. "D" shall mean compliance with deviations. For each deviation, provide a numbered footnote (i.e. D1, D2, D3, etc.) with a detailed explanation of how the intent of this specification is to be satisfied.

   c. "E" shall mean exception. The equipment offered is not in compliance with the specifications. For each exception, provide a numbered footnote (i.e. E1, E2, E3, etc.) with a detailed description of the exception.

1.7 RECORD DOCUMENTS

A. The Contractor shall maintain a record set of electrical prints at the project site and shall indicate thereon any changes made to the contract drawings, including, but not limited to addenda, field sketches, RFI responses, supplemental drawings, sketches, etc. Where changes are made that are reflective of supplemental instructions, revisions, RFI responses, etc., the Contractor shall make clear references to those changes.

B. A separate set of neat, legible electrical contract prints shall be kept at the project site at all times during the construction of the work for the express purpose of showing any and all changes indicated in paragraph A. above. The prints shall be marked up daily showing all changes to the original documents. The prints shall be marked up in a neat, legible manner using a red pen. Periodic review of the Record Documents will be conducted by the Owner's Representative or A/E. Should this review indicate that the Record Documents are deficient or not up to date, the Contractor shall immediately bring the documents into compliance and make the corrections

C. Upon completion of the project and before final close-out, the Contractor shall be responsible for producing a final set of record documents in electronic CADD format. One (1) set of full size prints, one (1) CD of the electronic CADD drawings (in AutoCad and pdf format), along with the red-lined marked up field set shall be delivered to the owner upon completion. If requested, the electronic CADD documents

shall be up-loaded to the owner's FTP site. The final CADD documents shall indicate in the title or revision block "RECORD DOCUMENTS" along with the date completed. The electronic format shall be compatible with the owner's preferred version of AutoCad. Coordinate with the owner before producing the CD or up-loading to the FTP site. Not acceptable are contractor installation drawings, shop drawings or multi-layers of work on a single drawing. The final as-built product shall mirror the contract bid documents using the project page layout, format and project title block.

D. Computer (CADD) files of electrical drawings will be made available to the Contractor upon receipt of a signed waiver (available upon request). One CD will be made available to the general contractor or construction manager for distribution to the trades.

E. Should the Contractor's electronic Record Documents not be considered complete, they will be returned for completion and/or correction.

1.8 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Upon completion of all work, the Contractor shall thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electrical equipment and systems. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance. Instructions shall be given only by experts in the equipment or systems and shall include descriptions and demonstrations for procedures of operation, data record keeping, etc.

B. The Contractor shall demonstrate, by actual usage, the proper operation of each and all portions of the various systems to the Owner or his appointed representative. Additional instructional periods shall be provided as required elsewhere in these specifications.

C. Following completion of the Electrical Contract and prior to the instructional period and final acceptance of the contract, the Contractor shall prepare three (3) Operating and Maintenance Manuals describing the electrical systems and equipment. Data in the manuals shall include, but not be limited to, the following:

1. Test results for all testing conducted in accordance with Division-26 Section, "Inspections, Testing and Start-up".

2. List of materials and equipment with name and address of vendor.

3. List of lamps, fuses (style and ampere rating), overload heaters, and other expendable equipment and devices with type, size or ordering description with name and address of vendor.

4. Operating, maintenance, and installation instructions for all systems and components with name and address of vendor and servicing supplier.

5. A certificate of approval from the Electrical Inspector.

6. A final copy of the approved coordination study.

7. Final copies of shop drawings and submittals.

8. Manufacturer's guarantees and warranties.

D. Manuals shall be of the loose leaf type, in heavy duty binders, with a master index and dividers with plastic tabs indicating system and equipment described.

1.9 RISER PLAQUE

A. Provide a computer generated riser diagram, 24" x 36" (600 mm x 900 mm) (nominal), of the completed distribution system showing incoming services, feeders, transformers, panelboards and related equipment. All feeders and circuits shall be sized and all equipment identified. Drawing shall be framed with plexiglass overlay.

1.10 GUARANTEE

A. Guarantee obligations shall be as hereinbefore specified in the GENERAL PROVISIONS of these specifications, except as follows:

1. Guarantee the complete electrical system free from all mechanical and electrical defects for a period of two (2) years beginning from the day of final acceptance of the work or beneficial occupancy by the Owner, whichever occurs first.

2. During the guarantee period, the Contractor shall be responsible for the proper adjustments of all systems, equipment and apparatus installed by him and do work necessary to insure efficient and proper functioning of the systems and equipment.

3. Upon receipt of notice from the Owner of failure of any part of the electrical installation during the guarantee period, new replacement parts shall be furnished and installed promptly at no cost.

4. Within the two (2) year warranty/guarantee period, manufacturer's recommended maintenance shall be provided by the Contractor.

1.11 DEFINITIONS

A. The following definitions apply to firestopping:

1. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

2. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.

3. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gases and smoke.

4. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

5. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, at wall tops between top of wall and ceiling, and structural floors or roof decks; and gaps between adjacent sections of structural floors.

6. System: Specific products and applications classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

7. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. All materials and equipment shall be new, the best of their respective kinds and suitable for the conditions and duties imposed on them. Replacement parts shall be available. A permanent service organization maintained or trained by the manufacturer shall be available for service.

B. The Contractor shall set-in place and connect all electrical equipment furnished under Division-26 and all other Divisions of the Contract.

C. Verify exact electrical service requirements for each piece of equipment receiving electrical connections. Provide proper service for each.

D. Include any and all items required by the National Electrical Code and field conditions for the proper connection and installation of each piece of equipment.

E. Products of one manufacturer shall be used where two or more items of the same kind are required.

2.2 EQUIPMENT DEVIATIONS

A. The Contractor shall be governed by the requirements of the GENERAL PROVISIONS of these specifications. After an item has been approved, no substitution will be permitted except where such substitution is considered by the Engineer to be in the best interest of the Owner.

B. The Contractor shall notify the Engineer of any changes in electrical characteristics of equipment being installed as opposed to that specified.

C. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, ductwork, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign, and all new drawings, and detailing required shall, with the approval of the Engineer, be prepared by the Contractor at the Contractor's own expense.

D. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit, and equipment from that specified or indicated on the drawings, with the approval of the Engineer, the Contractor shall furnish and install such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

2.3 FIRESTOPPING

A. All penetrations through fire barriers shall be firestopped with an approved material that is capable of maintaining the fire resistance rating of the barrier. All firestop sealants shall conform to ASTM E 814, ASTM E 119, UL 1479, UL 2079 CAN/ULC S115, and CAN/ULC S101.

B. Firestop material shall be latex based, intumescent caulk intended for use for all thru-penetrations with piping, ducts, cable trays, conduit, and cables.

C. When exposed to high temperatures or fires, the caulk shall expand in volume to quickly close off voids left by melting or burning construction materials. Caulk shall be applied by a standard caulk gun and remain flexible after curing.

D. Acceptable products shall be limited to Johns Manville "Firetemp-C1;" Hilti "FS-One;" or 3M "CP25WB+." Coordinate with General Contractor such that a single manufacturer/product is utilized throughout the project for all fire and smoke stopping materials.

2.4 SMOKE STOPPING

A. All penetrations through smoke barriers, smoke partitions, or any other surface required to resist the passage of smoke shall be provided with a smoke stop sealant and/or system that has been independently tested to provide an acceptable smoke seal that will resist the passage of smoke. Smoke stop systems (including product and installation) shall conform to all applicable standards (including but not limited to ASTM, UL and NFPA), as well as all other local, state or federal requirements.

B. Acceptable manufacturers shall be limited to the manufacturers that may provide firestopping materials/systems (see paragraph 2.03 of this section). Coordinate with the General Contractor such that a single manufacturer/product is utilized throughout the project for all fire and smoke stopping materials.

PART 3 - EXECUTION

3.1 SUPERVISION AND COORDINATION

A. The Contractor shall have competent supervision on the site at all times to layout, check, coordinate and supervise the installation of all electrical work and be responsible for the accuracy thereof. He shall plan the installation of all electrical work, giving consideration to the work of other trades, to prevent interference.

B. Determine the location, size, etc. of all chases, sleeve openings, etc. required for the proper installation of the electrical work and see that such are provided. All chases, sleeves, openings, etc. shall be set prior to erection of new work to prevent delay in the progress of other work or trades.

C. Conditions and/or situations which prevent the proper installation of any equipment or item where shown on the drawings shall be called to the attention of the Engineer for instructions.

D. Equipment shall be shipped or fabricated in sections of suitable size for entering the building and being removed from the finished building in the future if necessary.

E. Fully investigate all peculiarities and space limitations for all materials and equipment.

F. Outlet, pull and junction boxes and appliances which require operation, examination, adjustment, servicing or maintenance shall be readily accessible.

G. Take all field measurements necessary for this work and assume responsibility for their accuracy.

H. Coordinate the electrical work with all sub-contractors. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of electrical equipment. All electrical work shall be installed in proper sequence with other trades without any unnecessary delay.

I. Make all sub-contractors, suppliers and manufacturers fully aware of all requirements of the Contract.

J. Coordinate the spacing and arrangement of lighting fixtures, diffusers, grilles and access panels in ceilings to establish a symmetrical pattern. Unless otherwise indicated, items in modular ceiling systems shall be centered in individual tiles.

K. Coordinate the rough-in of all electrical work performed under other Divisions of these specifications.

L. Drawings indicate the approximate locations of outlets, apparatus and equipment. The runs of feeders and branch circuits as shown are schematic. Final routing is governed by structural conditions and other obstructions. This does not mean that the design may be changed; it merely refers to the exact run of a raceway between given points.

M. The drawings are diagrammatic and indicate the general arrangement of the equipment, the runs of conduit and the manner of connection.

N. The architectural, structural, mechanical, as well as the electrical drawings, shall be consulted in order to be entirely familiar with conditions to be encountered and special details.

O. The Contractor shall be solely responsible for the proper arrangement of conduit.

P. The Engineer shall make all final decisions as to any conditions which require the changing of any work.

Q. The electrical contractor shall coordinate fully with the elevator inspector for locations of disconnect switches, shunt trip devices, and all associated electrical work prior to installing. Fully coordinate with the elevator contractor's installation of the elevator, lift, walkway, wheel chair lifts, hoistways, etc. prior to laying out and installing any electrical equipment. Should the electrical contractor proceed without this coordination, they do so at their own risk.

3.2 STORAGE AND PROTECTION OF EQUIPMENT AND WORK

A. All materials and equipment shall be properly and effectively protected by the Contractor during the execution of the work.

B. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover, and shall not be stored at the construction site on the ground, in mud, water, snow, rain, sleet or dust. Large diameter cables may be stored on reels outside, however, all cable ends shall be waterproofed and the reels covered with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened and made impervious to the elements.

C. Conventional electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.

D. All gear and equipment, if delivered to the construction site before the building is under cover and the equipment site prepared shall be warehoused and protected. All gear and equipment shall be covered and protected from the elements and other damage and shall be stored in a clean, dry, heated atmosphere, under cover at the Contractor's expense.

E. All gear and equipment delivered to the construction site after the building is under cover shall be protected as described above and in

addition shall be provided with auxiliary heat to prevent condensation damage. The gear shall also be protected against damage caused by carelessness of workmen who are installing equipment connected to or adjacent to the above electrical equipment.

F. Equipment damaged as a result of the above conditions shall be properly repaired at the Contractor's expense or shall be replaced at the Contractor's expense, if, in the opinion of the Engineer the equipment has been damaged to such an extent it cannot operate properly after repairs are made.

G. All electrical enclosures exposed to construction damages such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs and pipe covering compound splashes, shall be completely covered and protected against damage.

H. In the event leakage into the building of any foreign material or fluid occurs or may occur, the Contractor shall take all steps as described above to protect any and all equipment.

I. After connections to electrical equipment are complete and the equipment is ready for operation, all construction debris shall be removed from all enclosures. Such debris includes dust, dirt, wire clippings, tape and insulation removed in order to make connections.

3.3 CUTTING AND PATCHING

A. All cutting of walls, floors, roofs, ceilings and/or partitions for the passage of conduit, etc., and closing up of superfluous openings around them in connection with the work under this contract, including the removal of all debris caused thereby, shall be performed by the Contractor.

B. All cutting, patching and finishing shall be performed in accordance with the requirements of the respective division of the specification and shall conform to adjacent work, subject to the approval of the Engineer.

C. Any work already in place that has been disturbed in the execution of the work shall be repaired and restored in harmony with the surrounding work.

D. Do not cut structural members without approval of the Engineer.

E. Patching shall be uniform in appearance and shall match with the surrounding surface.

3.4 PENETRATION OF WATERPROOF AND FIREPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction including roofs, exterior walls and interior waterproof construction. Where such penetrations are necessary, provide all necessary curbs, sleeves, shields, flashings, pitch pockets, fittings and caulking to make the penetrations absolutely watertight.

B. Where waterproofing or fireproofing have been removed or damaged in the execution of the work, the Contractor shall have such damage repaired by the respective trades working on the project.

C. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

D. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

E. Slots, sleeves and other penetrations in floors, wall or other general construction shall be closed and sealed with an approved firestopping material.

F. Floor slots and openings shall be closed with 16 gauge (1.6 mm) galvanized steel sheet supported on 1-inch by 1-inch by 1/8-inch (25 mm by 25 mm by 3 mm) structural angle drilled or supported with powder-driven studs into the building structure. Firestop with a layer of firestopping material not less than 1-inch (25 mm) thick which completely fills the opening. The top surface of the firestopping material shall be approximately 1-inch (25 mm) below the finished floor slab.

G. Openings in walls shall be closed with 16 gauge (1.6 mm) galvanized steel sheet securely attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/2-inch (13 mm) thick layer of non-sagging firestopping material to fully cover the opening.

H. Single or multiple pipes passing through walls and floors shall have the annulus space between pipes or between pipes and structure filled with firestopping material to provide a fire rating equal to the rating of the floors and walls being penetrated. The annulus between exposed conduit and walls or floors in finished spaces shall be filled, sealed, and painted to match adjacent surfaces.

I. In fire-rated partitions where horizontal separation of opposite-facing electrical boxes is less than 24 inches, provide UL listed firestop around electrical boxes as required to maintain fire rating of wall.

3.5 MANNER OF INSTALLATION

A. Provide equipment supports consisting of structural racks, hangers, rods, etc.

B. Equipment supports shall be designed and constructed to safely support and distribute loads evenly over building areas, and withstand stresses to which they may be subjected.

C. Coordinate the location and installation of supports and sleeves to be set in concrete.

D. Provide finish metal access doors and frames as indicated or required for access to concealed electrical equipment requiring inspection, adjustment, maintenance, manual operation, etc., or required by code.

E. In suspended metal pan, lay-in-panel, and accessible tile ceilings, the ceiling element may be used as the access panel.

F. Access doors in 1-1/2 hour fire-rated construction shall bear the Underwriter's Laboratories "B" label.

G. Floor-mounted equipment (switchboards, generators, transformers, sub-stations, starters, control cabinets, etc.) shall be provided with concrete foundations.

H. Concrete foundations shall be reinforced to suit the loads placed on them and shall be in strict accordance with the equipment manufacturer's recommendations. Concrete materials and methods shall be as specified in Division-3 of these specifications. The Contractor shall refer to this Division to determine specific requirements.

I. Unless otherwise indicated or required, concrete foundations shall extend 4-inches (100 mm) above the finished floor, at least 3-inches (75 mm) beyond the equipment base in all directions, shall have the top edges chamfered 1" (25 mm) and shall have the same surface finish as the adjacent and surrounding floor. Where equipment weight is such that the floor slab will support the equipment the concrete foundations shall be securely anchored to the floor slab with steel dowels. Properly prepare existing floors: remove paint or dirt, clean and scarify as necessary.

J. The Contractor shall furnish and set, with proper templates, all anchor bolts and inserts required for the proper attachment of his equipment to the concrete foundations. Anchor bolts shall be of the size and number required by the equipment and/or recommended by the equipment manufacturer and shall be in accordance with the requirements detailed on the drawings and/or specified herein. Anchor bolts shall also be

compatible where applicable, with vibration isolation requirements specified for the equipment. Anchor bolts shall be of adequate size and shall engage a steel plate of adequate dimensions cast into the slab.

K. The drawings indicate the wiring method. The number of current carrying conductors per raceway or cable shall be as indicated. The number of current carrying conductors cannot exceed three (3) per raceway or cable, unless the ampacity adjustment factors of NEC Article 310 are applied.

L. Each new and existing electrical penetration through a smoke and fire-rated wall, ceiling, or floor shall be sealed with an approved smoke and fire stopping method coordinated with the rating of the associated wall, ceiling, or floor construction.

3.6 CLEANING AND PAINTING

A. All equipment and conduit shall be thoroughly cleaned of all cutting waste from reaming and tapping. All burrs and other foreign matter shall be removed. Should any part of the system be stopped up by such refuse after the various equipment and apparatus have been accepted, the Contractor shall be required to pay for all labor and materials required to locate and remove the obstruction, and replace and repair all work in any way disturbed thereby. All enclosures, etc., shall be cleaned of all rubbish, plaster, and other debris at the completion of the work.

B. Paint all exposed metal surfaces, except for galvanized surfaces and extruded aluminum cable and wire duct, of all electrical equipment in mechanical rooms and equipment spaces. Paint all backboards in all telephone and electrical rooms.

C. Do not paint nameplates or other elements where such application would interfere with operation or maintenance of equipment.

D. All scratches or marred areas on factory painted equipment shall be touched up to match finish.

3.7 IDENTIFICATION

A. Equipment (disconnects, panelboards, starters, relays, switches with pilot lights, pushbutton stations, etc.) shall be identified as to its function, equipment, or area served, etc. In finished areas and mechanical rooms and equipment spaces identification shall be engraved phenolic plates with approximate 3/16" (5 mm) high black letters on white background. Equipment connected to the emergency power system shall be provided

with phenolic plates utilizing white letters on red background. Plates shall be attached to front of devices with stainless steel, oval head, machine screws. Panelboards and equipment cabinets shall also be identified with stenciled letters, 3/4" (19 mm) high, on inside of cabinet door, colored to contrast with background.

B. All conduits containing electrical feeders shall be identified with vinyl cloth pipe markers by W.H. Brady or Seton. Labels shall be applied whenever a conduit enters or leaves a switchboard, panelboard, or a junction or pull box, and at each side of penetrations of walls or floors. Provide individual numbers and letters to indicate feeder number and voltage.

C. All pull box and junction box covers shall be stenciled to indicate voltage, service and/or system. All stenciling shall be clear and legible from a distance of five (5) feet.

D. No embossed plastic tape markers will be permitted for use in marking equipment.

E. All underground feeders, branch circuits, ductbanks, etc. shall be identified with a continuous plastic tape equal to Allen Marking Tape. Tape shall be six inches wide, waterproof, chemically resistant, yellow marked "Caution - Buried Electrical Line Below". Tape shall be located approximately midway from grade to top of feeder.

F. Receptacle Cover Plates: Provide label on front of cover plate unless otherwise noted. Label shall indicate source panel and circuit number. Label shall be a laminated, adhesive backed, peel-off, polyester type label. Label shall be comprised of a polyester base/substrate and a clear polyester top layer/laminate. The label ink shall be printed underneath the clear polyester laminate. Label shall have black lettering on clear background. Label width shall be a nominal 0.47" (12 mm) wide. Basis of design is the TZe labeling tape by Brother Mobile Solutions, Inc. For use with the Brother P-Touch EDGE Series labeling tools.

G. All identification shall be subject to the approval of the Engineer.

3.8 EXAMINATION OF SITE

A. The Contractor shall examine the premises prior to submitting his bid and observe the conditions under which the work will be done or other circumstances which will affect the contemplated work. No allowance will be made for any work in connection with any error or negligence on the Contractor's part. No claim for extra compensation will be recognized

for difficulties encountered which, in the opinion of the Owner, would have been revealed by proper examination.

3.9 WORKMANSHIP

A. All materials and equipment shall be installed and completed in a first class workmanlike manner and in accordance with the best modern methods and practice. Any materials installed which do not present an orderly and reasonably neat or workmanlike appearance shall be removed and replaced when so directed by the Engineer. The removal and replacement of this work shall be done, when directed in writing by the Engineer, at the Contractor's expense.

3.10 REPAIR OF EXISTING PROPERTY

A. All work shall be carefully laid out in advance, and where cutting, channeling, chasing, trenching, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of raceways, outlet boxes, or other electrical work, this work shall be carefully done, and any damage to building, piping, equipment, or ground shall be properly repaired by skilled mechanics of the trades involved, at no additional cost to the Owner.

3.11 TEMPORARY ELECTRICAL SERVICE

A. The Contractor shall provide temporary electrical service on the site as is necessary to enable his work and the work of others on the job to proceed and to test the operation of all apparatus, devices, systems which require electrical energy.

B. The Contractor is responsible for temporary power as may be required for construction or as may be required to maintain critical operations during changeover of feeders or services. The Contractor is responsible for providing all equipment, making all arrangements (including all work needed to submit a service application to the power company), and making all connections required for temporary power.

C. The Contractor shall disconnect and remove all equipment and facilities required for temporary power at the completion of the project.

3.12 UTILITY REBATES

A. The electrical contractor shall coordinate all aspects of the utility rebate program as it pertains to lighting and lighting control rebates (and other qualifying equipment being installed by the electrical contractor). This includes contacting the rebate facilitator to determine if pre-approval is required. Note: This is important because pre-approval may be required prior to demolition of existing light fixtures and controls. This will impact the construction sequence/schedule.

B. Utility Rebate Application: The electrical contractor shall provide and submit a utility rebate application to the local utility for the light fixtures and lighting controls (and other qualifying equipment being installed by the electrical contractor). The rebate application shall include all information required by the utility company program administrator (ICF International, or other rebate administrator) including, but not limited to, the application, existing light fixture part numbers, existing lamp information, etc.; all as defined and/or required by the program administrator. The Owner shall be indicated on the application as the recipient for the full rebate.

3.13 PUNCH-OUT PROCEDURES

A. Preliminary Punch-out:

1. Prior to requesting an inspection from the Owner, Engineer, or Permit Official, the General Contractor or Construction Manager (GC or CM) shall provide a preliminary punch-out of the area in question.

2. Once completed, their punch list shall be supplied to each trade for corrections and completion. The punch list shall also be provided to the Engineer for their use.

3. Upon being informed that the trade contractors have addressed all of the outstanding items, the GC / CM shall backcheck the work and update the punch list.

B. Final Punch-out:

1. Final punch-out by the engineer shall not commence until the GC or CM has exhausted their review and has signed off on all items.

2. A copy of the sign-off shall be provided to the Engineer for their record.

3. Once the above has been completed, the Engineer shall be notified that the work is substantially complete and ready for a final punch-out.

4. Depending on the size, schedule, and project complexity, punch-outs may be requested for specific areas or systems, rather than the facility as a whole. Examples of specific requests include the following:

    a. Above ceiling

    b. Equipment rooms

END OF SECTION

SECTION 26 0200 - PROJECT CLOSEOUT ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This section provides a summary of the primary electrical project closeout activities, however, this section does not attempt to address all project closeout requirements. Closeout activities referenced in this section include the following:

1. Testing
2. Start-up
3. Punch-out Procedures
4. Operation and Maintenance Manuals (O & M Manuals)
5. Demonstration and Training
6. Record Documents
7. Close-out Documents

B. This Section shall not supersede any other close-out section or requirements of the Contract. Refer to other Divisions of the specifications and the General Requirements of the Contract for further instructions.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 TESTING

A. The Contractor shall perform systems and equipment inspections and tests as specified in each Division-28 and Division-26 specifications section. Particular attention shall be paid to Division-26 section "Inspections, Testing and Start-up."

B. An independent testing firm shall perform systems and equipment inspections and tests as specified in each Division-26 section. Particular attention shall be paid to Division-26 section "Inspections, Testing and Start-up."

3.2 START-UP

A. The Contractor shall perform start-up on each piece of electrical equipment as specified in each section of Division-26.

B. Where indicated in each section of Division-26, the services of a factory authorized and certified technician shall be required to perform the equipment start-up. Start-up by any other organization other than as required by the manufacturer is unacceptable.

C. Start-up reports shall be provided for all equipment and be included in the final O & M Manuals.

3.3 PUNCH-OUT PROCEDURES

A. Preliminary Punch-out:

1. Prior to requesting an inspection from the Owner, Engineer, or Permit Official, the General Contractor or Construction Manager (GC or CM) shall provide a preliminary punch-out of the area in question.

2. Once completed, their punch list shall be supplied to each trade for corrections and completion. The punch list shall also be provided to the Engineer for their use.

3. Upon being informed that the trade contractors have addressed all of the outstanding items, the GC / CM shall backcheck the work and update the punch list.

B. Final Punch-out:

1. Final punch-out by the engineer shall not commence until the GC or CM has exhausted their review and has signed off on all items.

2. A copy of the sign-off shall be provided to the Engineer for their record.

3. Once the above has been completed, the Engineer shall be notified that the work is substantially complete and ready for a final punch-out.

4. Depending on the size, schedule, and project complexity, punch-outs may be requested for specific areas or systems, rather than the facility as a whole. Examples of specific requests include the following:

    a. Above ceiling

    b. Mock-ups for any repetitive installation to confirm acceptance prior to continuing (dorms, offices, etc.)

    c. Equipment rooms

C. Upon completion of any and all punch lists (i.e. above ceiling, final, partial, phased, factory review, or specific item) the contractor shall provide an item by item sign-off indicating the date and who completed the item. The sign-off shall be submitted to the A/E and owner before final payment is processed. Should the contractor disagree with any item, they shall provide a written exception giving reason for review.

3.4 OPERATION AND MAINTENANCE MANUALS

A. Submit Operation and Maintenance Manuals in three-ring binders with each section separated by tab dividers. Include protective plastic sleeves for any software or folded large documents submitted.

B. At a minimum, the manual shall contain the following:

1. Test results for all testing conducted in accordance with Division-26 Section, "Inspections, Testing and Start-up".

2. List of materials and equipment with name and address of vendor.

3. List of lamps, fuses (style and ampere rating), overload heaters, and other expendable equipment and devices with type, size or ordering description with name and address of vendor.

4. Operating, maintenance, and installation instructions for all systems and components with name and address of vendor and servicing supplier.

5. A certificate of approval from the Electrical Inspector.

6. A final copy of the approved coordination study.

7. Final copies of shop drawings and submittals.

8. Manufacturer's guarantees and warranties.

9. A full compliance statement, on company letterhead, indicating that all systems are installed and functioning per the contract requirements including drawings, specifications, control sequences and accepted submittals.

C. The O & M manuals shall be submitted to the A/E for review of general conformance.

3.5 DEMONSTRATION AND TRAINING

A. Upon completion of work, instruct the owner's representative in the proper operation and maintenance of each electrical system in accordance with applicable specification sections.

B. Instructions shall be given by persons expert in the operation and maintenance of each system / equipment.

C. Prepare statement(s) for signing by Owner's representative indicating the date of completion of instructions and hours expended. Furnish copies of signed statements to the A/E.

D. Final demonstration of all electrical equipment shall be recorded in DVD compatible format. Provide DVD's to the Owner.

3.6 RECORD DOCUMENTS

A. The Contractor shall maintain a record set of electrical prints at the project site and shall indicate thereon any changes made to the contract drawings, including, but not limited to addenda, field sketches, RFI responses, supplemental drawings, sketches, etc. Where changes are made that are reflective of supplemental instructions, revisions, RFI responses, etc., the Contractor shall make clear references to those changes.

B. A separate set of neat, legible electrical contract prints shall be kept at the project site at all times during the construction of the work for the express purpose of showing any and all changes indicated in paragraph A. above. The prints shall be marked up daily showing all changes to the original documents. The prints shall be marked up in a neat, legible manner using a red pen. Periodic review of the Record Documents will be conducted by the Owner's Representative or A/E. Should this review indicate that the Record Documents are deficient or not up to date, the Contractor shall immediately bring the documents into compliance and make the corrections

C. Upon completion of the project and before final close-out, the Contractor shall be responsible for producing a final set of record documents in electronic CADD format. One (1) set of full size prints, one (1) CD of the electronic CADD drawings (in AutoCad and pdf format), along with the red-lined marked up field set shall be delivered to the owner upon completion. If requested, the electronic CADD documents shall be up-loaded to the owner's FTP site. The final CADD documents shall indicate in the title or revision block "RECORD DOCUMENTS" along with the date completed. The electronic format shall be compatible with the owner's preferred version of AutoCad. Coordinate with the owner before producing the CD or up-loading to the FTP site. Not acceptable are contractor installation drawings, shop drawings or multi-layers of work on a single drawing. The final as-built product shall mirror the contract bid documents using the project page layout, format and project title block.

D. Computer (CADD) files of electrical drawings will be made available to the Contractor upon receipt of a signed waiver (available upon request). One CD will be made available to the general contractor or construction manager for distribution to the trades.

E. Should the Contractor's electronic Record Documents not be considered complete, they will be returned for completion and/or correction.

3.7 CLOSEOUT DOCUMENTS

A. Prior to Substantial Completion and /or Final Payment, the Contractor shall prepare and submit the following:

1. Final punch lists indicating completion of all items.
2. All record drawings.
3. All record specifications.
4. Operation and Maintenance Manuals.
5. Complete final cleaning.
6. Remove temporary facilities and complete site restoration.
7. Where lightning protection system work is provided, provide UL Master Label Certificate.

END OF SECTION

SECTION 26 0501 - INSPECTIONS, TESTING AND START-UP

PART 1 - GENERAL

1.1 DESCRIPTION

A. The intent of the inspection, testing, and check-out work specified herein is to ensure that all electrical workmanship and equipment, whether Owner furnished or Contractor furnished, is installed and performs in accordance with the Contract Documents, manufacturer's instructions and all applicable codes and requirements. Also, it is intended to ensure the following:

1. Equipment has not been subjected to damage during shipment or installation.

2. Equipment is in accordance with the specifications.

3. A bench mark is established for routine maintenance and troubleshooting.

4. Successful start-up without last minute interruptions and delays.

5. Each system component is installed satisfactorily and will perform its function reliably throughout its life and the life of the overall system.

B. Testing requirements in other sections of this Specification are intended to compliment and not supersede nor be superseded by this Section.

1.2 RELATED SECTIONS

A. Division-01Section - Submittals.

B. Division-01 Section - Quality Control.

C. Division-01 Section - Materials and Equipment.

D. Division-26 - Electrical Specifications.

1.3 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI C2, National Electrical Safety Code

2. ANSI Z244-1, American National Standard for Personnel Protection

B. American Society of Testing and Materials (ASTM)

C. Institute of Electrical and Electronic Engineers (IEEE)

D. Insulated Cable Engineers Association (ICEA)

E. International Electrical Testing Association (NETA)

F. National Electrical Manufacturer's Association (NEMA)

G. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70, National Electrical Code

2. ANSI/NFPA 70B, Electrical Equipment Maintenance

3. ANSI/NFPA 70E, Electrical Safety Requirements for Employee Workplaces

4. ANSI/NFPA 780, Lightning Protection Code

H. Occupational Safety and Health Administration (OSHA)

I. State and Local Codes and Ordinances

1.4 SUBMITTALS

A. Provide resumes for personnel conducting tests and evidence of the testing firm's qualifications, accreditation and experience.

B. Provide a list of test equipment to be utilized including the manufacturer's name, model number, serial number, accuracy, and last date of calibration.

C. Provide industry standards or guide specifications used in lieu of National Standards.

D. Provide testing procedures and schedules.

1.5 TESTING FIRM

A. When an independent testing firm is utilized, the following shall apply. The testing firm shall be a competent, independent electrical equipment testing laboratory or organization. The testing firm shall not be a subsidiary, division, nor department of either the installing Contractor or the manufacturer of the equipment materials or systems being inspected and tested. The testing firm shall be a fully accredited member of the International Electrical Testing Association (NETA) and have the specialized experience and skill in the supervision and performance of all inspection and testing specified herein.

1.6 TEST INSTRUMENT CALIBRATION

A. The testing firm or contractor shall have a calibration program which assures that all applicable test instrumentation is maintained within rated accuracy.

B. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

C. Instruments shall be calibrated in accordance with the following frequency schedule:

1. Field instruments, analog: six (6) months.

2. Field instruments, digital: twelve (12) months.

3. Laboratory instruments: twelve (12) months.

4. Leased specialty equipment: twelve (12) months.

D. Calibration labels shall be visible on all equipment and shall have a date of calibration and due date. Calibration records shall be available for review by the Owner.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 COORDINATION

A. Provide all necessary supervision and labor, materials, tools, test instruments and other equipment or services required to inspect, test, adjust, set, calibrate, functionally and operationally check all work and equipment.

B. When an independent testing firm is utilized, provide a set of contract documents to the testing firm.

C. When an independent testing firm is utilized, provide a copy of the approved short-circuit and protective device coordination study to the testing firm.

D. Provide the testing firm a set of approved submittals and shop drawings for the equipment to be tested by the testing firm.

E. Prepare procedures and schedules for all inspections, tests, settings and calibrations specified or otherwise required. The procedures must provide specific instructions for the checking and testing of each component in addition to the system functional checks. All procedures submitted shall include proposed job safety rules.

F. Provide a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements. The Owner shall approve all sources of electrical power for testing.

G. Notify the Owner prior to the commencement of any testing.

3.2 INSPECTIONS AND TESTS

A. Equipment purchased by the Contractor or purchased by the Owner but installed by the Contractor shall be inspected and tested to determine its condition.

B. The inspections, tests and checks described herein shall not be considered as complete and all inclusive. Additional normal standard construction (and sometimes repetitive) checks and tests shall be provided as necessary throughout the project, prior to final acceptance by the Owner.

C. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty, or requiring

repairs shall be reported to the Owner. Corrective action may require prior approval.

D. Perform routine insulation resistance, continuity and phase rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

E. At the option of the Contractor, either an independent testing firm or the Contractor shall provide testing of the following systems and equipment.

1. 480 volt switchgear and switchboards
2. Dry type transformers
3. Grounding systems
4. Ground fault systems
5. 480 volt circuit breakers rated 400 amperes and greater
6. Instrument transformers
7. Metering and instrumentation
8. Generator sets

F. At the option of the Contractor, either an independent testing firm or the Contractor shall provide visual and mechanical inspections of the following systems and equipment.

1. Panelboards
2. Dry type distribution transformers (600 volt and below)
3. Low voltage wiring (600 volt and below)
4. Molded case circuit breakers rated less than 400 amperes
5. Automatic transfer switches
6. Motor control
7. Air switches (600 volt and below)
8. Lighting control system
9. Fire detection and alarm system

G. All circuit breakers and protective devices shall be set and tested at the settings specified in the approved protective device coordination study. All fuses shall be selected and installed in accordance with the approved coordination study.

H. All circuit breakers and protective devices shall be set as recommended by the manufacturer and tested at those settings. All fuses shall be selected and installed in accordance with the manufacturer's recommendations.

I. The rotation of all motors shall be checked and corrective action shall be taken where necessary to obtain correct rotation.

J. Engagement of an independent testing firm in no way relieves the Contractor of the responsibility for the performance of the many and varied tests, checkouts, and inspections required during the various stages of construction.

3.3 CERTIFICATION

A. Provide certified test reports. Test reports shall meet the criteria specified in OSHA Regulation Part 1907, "Accreditation of Testing Laboratories". The certification shall attest to the fact that the electrical installation has been installed and tested in accordance with the applicable National Standards or, where no National Standard exists, the applicable industry standard or guide specification for the equipment involved.

B. The following information shall be included in the test reports.

1. Description of equipment tested (manufacturer, model number, serial number).

2. Description of test and standards used.

3. Description of test equipment.

4. Test results with pass/fail criteria.

5. Conclusions and recommendations.

6. Names of personnel conducting the test.

C. When testing is provided by an independent firm, the report shall be signed by a Registered Professional Engineer.

D. Provide three (3) copies of the complete test report no later than thirty (30) days following completion of the tests.

END OF SECTION

SECTION 26 0519 - WIRES AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this Section.

1.2 SUMMARY

A. The Contractor shall provide, install and terminate all wires and cables for power, lighting, signal, control and related systems rated 600 volts and less.

1.3 SUBMITTALS

A. Submit product data for electrical wires, cables and connectors.

1.4 QUALITY ASSURANCE

A. All wires, cables and connectors and the installation of wires, cables and connectors shall comply with the following standards:

1. NFPA 70 "National Electrical Code."
2. UL Standards pertaining to wires and cables:
    a. UL Std 44, Rubber Insulated Wires and Cables
    b. UL Std 83, Thermoplastic - Insulated Wires and Cables
    c. UL Std 486A, Wire Connectors and Soldering Lugs for Use with Copper Conductors, UL Std 486B for Use with Copper or Aluminum
    d. UL Std 854, Service Entrance Cable
3. Applicable NEMA Standards pertaining to wires and cables.
4. Applicable IEEE Standards pertaining to wires and cables.

B. Wires, cables and connectors shall be listed and labeled by UL.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES

A. All wiring #14 and larger shall be soft drawn copper, 98 percent conductivity, 600 volt insulation, type THHN/THWN.

B. All wiring connections to lighting fixtures shall have insulation suitable for the temperatures to be encountered in accordance with the NEC.

C. All wiring #8 and larger for feeders and branch circuits shall be stranded.

D. Minimum wire sizes shall be #12 for power and lighting circuits and #14 for control circuits unless otherwise noted.

E. All wiring shall have identification markings along the outer covering denoting conductor size, type of insulation, and manufacturer's trade name. All wiring shall be color coded as follows:

PHASE	**120/208 VOLTS**	**277/480 VOLTS**
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

F. Wiring in sizes up to #8 shall have colored insulation, wiring in sizes #6 and larger shall be coded by colored tape applied no more than 6 inches (150 mm) from each termination and spanning a minimum length of 6 inches (150 mm) of insulation.

G. All emergency wiring shall be clearly identified as emergency in all outlets, fixtures, etc.

H. Direct burial conductors and cables shall be Type USE (UL 44).

2.2 METAL CLAD (MC) CABLE

A. The maximum allowable branch circuit conductor size utilizing MC cable shall be #10 AWG.

B. The following standards shall apply:

1. UL Standard 1569 for MC Cable

2. UL Standard 83 for Thermoplastic Insulated Wires

3. Federal Specification J-C-30B

4. NEC Article 330

C. Each circuit conductor and the grounding conductor shall be solid, uncoated copper insulated with PVC and jacketed with nylon complying with the physical and electrical requirements of UL Standard 83 for type THHN.

D. All cables shall contain a green THHN grounding conductor.

E. The cables shall be rated 194°F (90°C) and 600 volts.

F. Fittings: As specified in Division 26 "Raceways" for flexible metal conduits.

G. Connections:

1. Provide UL listed lugs marked "AL7CU" or "AL9CU" as per the requirements of UL Standard 486B.

2. Wire brush the conductor and apply an oxide inhibiting joint compound, Penetrox or equivalent.

3. Provide the proper torque per the connector manufacturer's recommendation.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring shall not be installed until building is under roof.

B. All wiring for lighting and power circuits shall be sized as follows unless

otherwise indicated:

120 Volt Branch Circuit Length	**Wire Size**
0-75' (0-22.5 m)...	#12
75-150' (22.5-45 m).....	#10
Over 150' (Over 45 m).....	# 8

277 Volt Branch Circuit Length	**Wire Size**
0-200' (0-60 m).....	#12
Over 200' (Over 60m).....	#10

C. In accordance with the above where the size of branch circuit conductors is increased by the minimum required by the NEC for the branch circuit rating, it is the Contractor's responsibility to ensure that the termination provisions of all equipment connected to such circuits are listed as suitable for the conductor sizes involved.

D. Emergency lighting and exit sign circuits shall not be installed in raceway, boxes, etc. with other wiring systems, except at lighting fixtures.

E. Wire pulling compounds shall be polywater or equivalent. The use of oils and greases shall not be permitted.

F. All field-installed control wire and cable terminating in motor control centers, panelboards, junction boxes, etc. shall be identified with pre-stamped tubular type markers or pressure sensitive linen labels covered with clear heat shrinkable tubing. Labels shall indicate circuit numbers, terminal numbers, etc. of each conductor. The identification labels shall be as manufactured by the W.H. Brady Company, Tyton, or equivalent.

G. No conductors shall be installed in raceways before the raceway system is properly installed and all work on the building which is liable to injure the conductors has been completed. Immediately before installing the conductors, the raceway, fittings and boxes shall be thoroughly cleaned and dried.

H. The sharing of the neutral conductor for branch circuits is prohibited unless specifically called for on the drawings.

I. Conductors shall be continuous between cabinets, outlets and/or junction boxes; no splices or taps shall be made within the raceway itself. Under no circumstances shall feeder conductors be spliced.

J. At least six inches (150 mm) of free conductors shall be left at each outlet, cabinet, junction box, etc. where they are connected or spliced.

K. Wiring devices shall not be used as splices; pigtails (line, neutral and grounding) from circuit wiring shall be provided to allow removal of the device without opening the circuit.

L. Wiring in cabinets shall be neatly laced or tied.

M. Underground direct burial single conductor wiring shall be tied together at intervals not exceeding 10 feet (3 m). The requirements for installation of underground raceways also apply to underground direct burial wiring.

N. Cable reels shall be secured to the overhead structure. Ceiling support wires and framing shall not be used to support cable reels.

O. Cable reel ball stops shall be adjusted to provide a maximum retracted height for receptacles at 78 inches (1950 mm) above the finished floor.

P. All wiring on the secondary side of isolated power units low leakage insulation type as manufactured by Rome Cable Corporation type ELP or equivalent. Under no circumstances shall wire pulling compound be utilized when pulling wires on the secondary side of isolated power units.

Q. Provide a grounded circuit conductor (neutral) to all wall switch locations.

3.2 METAL CLAD (MC) CABLE INSTALLATION

A. MC cable shall not be used within electrical rooms, mechanical rooms, janitor's closets, or in any exposed locations.

B. MC cable shall not be used for feeders or branch circuit homeruns.

C. MC cable shall be clipped directly to walls using clips or straps supplied by the manufacturer. Spacing of supports for non-fire rated circuits shall not exceed 6 feet (1800 mm) on center.

D. Minimum bend radius shall be as recommended by the manufacturer.

E. MC cable may be used for lighting whips; maximum 6 foot length, in accessible locations.

F. MC cable may be used for branch circuits within partition walls. Horizontal branch circuit runs not within partition walls shall be in conduit.

3.3 TESTING

A. Feeders shall be checked using a megohm tester to determine the insulation resistance levels prior to energizing.

B. Branch circuits shall be tested to ensure electrical continuity and to ensure the system is free of short-circuits.

END OF SECTION

SECTION 26 0526 - GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies general grounding and bonding requirements for all electrical installations.

1.2 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

1.3 SUMMARY

A. All systems, circuits and equipment shall be grounded and bonded in accordance with Article 250 of the National Electrical Code and the requirements of these Specifications and the Drawings.

1.4 SUBMITTALS

A. In accordance with section Submittals and Division-26 Section, "Basic Electrical Materials and Methods", the following shall be furnished:

1. Test Reports: Certified test reports of ground resistance.

2. Certifications: Two weeks prior to final inspection, deliver to the Owner six (6) copies of the certification that the materials and installation are in accordance with the drawings and specifications and have been properly installed.

3. Provide product data for all grounding and bonding components and accessories.

1.5 QUALITY ASSURANCE

A. All grounding components and accessories shall comply with and shall be installed in accordance with NFPA 70, Article 250 of the National Electrical Code, and applicable sections of UL Std 467, "Electrical Grounding and Bonding Equipment", and UL Std 869, "Electrical Service

Equipment".

B. Grounding and bonding components and accessories shall be UL listed and labeled for the specific application for which they are being used.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING

A. Provide electrical grounding and bonding components and accessories including, but not limited to, cables and wires, connectors, terminals, jumpers and surge arresters as required for a complete installation.

B. Where more than one product meets the intended requirements, selection shall be at the discretion of the Installer.

C. Provide electrical insulating tape, heat-shrinkable tubing, welding materials, straps and jumpers as recommended by manufacturer's written instructions and in accordance with standard industry practices.

D. All below grade grounding connections shall be exothermic welds and splices and shall be by Caldweld or equal. All materials shall be supplied by one manufacturer to ensure compatibility.

2.2 GROUNDING CONDUCTORS

A. Provide a grounding conductor with green insulation.

B. General purpose insulating grounding conductors have insulation types as identified by the NEC and tested, certified, and labeled in accordance with UL Standards.

C. Non-insulated grounding conductors shall be bare, soft drawn, single or multiple strand annealed copper in wire gauges or sizes as shown on the drawings or consistent with the requirements of NEC Article 250.

2.3 GROUND RODS

A. Ground rods shall be copper clad, solid steel round bars, 3/4 inches (19 mm) in diameter and 10 feet (3 m) in length.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. All equipment, conduit systems, raceway systems, metallic enclosures of electrical devices, switchgear enclosures, transformer frames and equipment, wiring devices and all metallic non-current carrying devices, etc. shall be completely grounded in accordance with the requirements of the National Electrical Code (latest edition).

B. Grounding conductors shall be installed within conduit and shall be sized in accordance with NEC Article 250.

C. Grounding conductors installed below grade shall be buried at least 24" below grade.

D. Continuity of rigid steel raceways shall be insured by conduit hubs. All grounded neutral conductors shall be continuously identified. All grounding and bonding connections shall be solderless. All grounding and bonding connections to structural steel shall be exothermic welds. Ground fittings at water system connections shall have rigid clamp jaws. Perforated grounding straps shall not be acceptable.

E. The secondary neutral conductor of transformers shall be continuous, identified throughout and grounded in an approved manner to the grounding electrode system. Conductor used to ground neutral conductor shall be sized in accordance with NEC Article 250.

F. Provide insulated grounding conductors for all feeders and branch circuits. Provide grounding blocks, terminals, etc. for connection of ground wires in all distribution equipment, outlets, junction boxes and utilization equipment.

G. Provide bonding for all metal piping systems and structural steel. Provide bonding connections to cold water and hot water, metal sanitary, gas piping and structural steel. Provide braided copper jumpers at meter, valves, equipment, etc. Bonding shall be in accordance with NEC Article 250.

H. All grounding wire, lugs, jumpers and bus shall be copper except as specifically approved elsewhere in these Specifications.

I. Where parallel feeders are used, each raceway shall contain an equipment ground conductor sized in accordance with NEC Article 250 for the combined parallel circuit amperage.

J. Grounding electrode conductor shall be continuous and no splicing shall be allowed. Equipment grounding conductor splices shall be permitted in device boxes and pulling points, but should be minimized to keep ground resistance as low as possible.

K. Receptacles shall be bonded to their outlet boxes with #12 copper straps. Straps may be omitted if self-grounding devices are utilized.

L. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

2. For grounding electrode system, install at least [three] <Insert number> 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. Make these connections in addition to the main water service entrance, building steel, and foundation rebar.

3.2 TESTING

A. The ground resistance at the main switchboard ground bus shall not exceed 10 ohms.

B. The ground resistance at outdoor pad mounted equipment shall not exceed 5 ohms.

C. Resistance shall be tested by the fall of potential method according to IEEE 81.

1. Measure ground resistance not less 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.

2. If resistance levels are excessive, take additional steps to reduce resistance to acceptable levels (at no cost to the owner). Drive additional ground rods, provide additional grounding electrode conductors, etc. as needed to reduce resistance. Describe methods used to improve results within test report.

D. Certified test results shall be provided in accordance with the

requirements of Division-26 Section, "Inspections, Testing and Start-up" of these Specifications.

END OF SECTION

SECTION 26 0529 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

1.2 SUMMARY

A. Support all raceways, enclosures, cabinets, boxes, and related electrical equipment from the building structure as required by the NEC and as described in these Specifications.

B. Support all lighting fixtures as required by the NEC and as described in these Specifications.

1.3 SUBMITTALS

A. Provide product data for each type of manufactured supporting device.

B. Provide shop drawings for each type of fabricated supporting device.

1.4 QUALITY ASSURANCE

A. All components and the installation of all components shall comply with NFPA 70, "National Electrical Code," requirements.

B. All supporting devices shall be listed and labeled by UL, ETL, CSA or a Nationally Recognized Testing Laboratory (NRTL).

C. Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports and equipment mounting.

PART 2 - PRODUCTS

2.1 PROHIBITED MATERIALS

A. Nails, wires, perforated tape or plumber's tape are unacceptable for supporting or securing conduits.

2.2 MANUFACTURED SUPPORTING DEVICES

A. Supporting devices shall comply with manufacturer's standard design and construction, fabricated from standard materials in accordance with published product information.

B. Supporting devices shall be protected with a zinc coating or with a similar corrosion resistant coating or treatment. Devices for use outdoors shall be hot-dip galvanized.

C. Raceways shall be supported using clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

D. Steel channels and associated support rods shall be selected to accommodate weight of associated raceway and wire.

E. Anchors shall be provided of adequate size to support the load, and shall be compatible with the construction method encountered. Anchors shall be expansion or toggle bolt type.

2.3 FABRICATED SUPPORTING DEVICES

A. Pipe sleeves shall be fabricated from galvanized sheet steel or Schedule 40 galvanized steel pipe.

B. Sheet steel sleeves shall be round tube closed with snaplock, joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gauge steel: 3" (75 mm) and smaller, 20 gauge (1.0 mm); 4" to 6" (100 mm to 150 mm), 16 gauge (1.6 mm); over 6" (150 mm), 14 gauge (2.0 mm).

C. Steel brackets shall be fabricated from angles, channels and other standard shapes. Brackets shall be assembled using welds and/or machine bolts to form a rigid assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instruction and following recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Install supports within maximum spacing indicated by NEC or on drawings.

D. Individual conduits shall be secured with steel pipe straps or lay-in pipe hangers.

E. Multiple runs of suspended conduit shall be supported from trapeze style hangers.

F. Multiple runs of conduit on ceiling or wall surfaces shall be mounted on flush or surface steel channels.

G. Ceiling support wires shall not be used for support of conduits.

H. Lighting fixtures shall be supported as recommended by the manufacturer. Recessed fixtures in suspended ceilings shall not be supported by the ceiling system. Fixtures shall be secured to the building's structure.

I. Raceway supports shall be adequate to carry present and future load multiplied by a safety factor of at least four. In no case shall a support strength of less than 200 pounds (1380 kPa) be used.

J. Manufactured watertight and fire-rated seals shall be provided for sealing conduits and cables passing through sleeves in floors and fire-rated walls. Seals shall be fire-resistant rubber plugs or other materials specifically designed to provide a watertight seal and a UL listed fire-resistant rating which meets or exceeds the rating of the floor or wall.

K. All penetrations through floors or fire-rated walls shall be sealed to restore the fire rating around such penetrations. The sealing system shall fill all

voids, shall be specifically designed for such use, and shall have a UL listed fire-resistant rating which meets or exceeds the rating of the floor or wall.

L. Cable supports shall be provided for vertical conduits in accordance with NEC Article 300. Cable supports shall be multi-section wedge-type plugs with an outside diameter and the number and size of openings required for the conduit and conductors.

M. Provide vibration isolators between enclosures of all vibration producing equipment, transformers, etc., and their supports or floor. Isolators shall be Mason Industrial type NK neoprene and cork sandwich or equal.

N. Supports are required within 3 feet (900 mm) of each outlet box, junction box, device box, cabinet, conduit body or other tubing terminations.

O. All junction boxes shall be supported from structure.

END OF SECTION

SECTION 26 0533 - RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this Section.

1.2 SUMMARY

A. All wiring shall be installed in raceways as hereinafter specified, unless otherwise indicated.

1.3 SUBMITTALS

A. Submit product data for raceways, wireways and fittings.

B. Submit manufacturer's written installation instructions for wireways, surface raceways and non-metallic raceways.

C. Submit pulling calculations for all underground ductbank runs having cables larger than 4/0.

D. For prewired surface raceway installations, submit drawings for approval showing the complete layout of all products that make up the complete system for each floor prior to installation with raceway lengths, device type (power or data), locations and circuits identified.

1.4 QUALITY ASSURANCE

A. All raceway components and the installation of raceway components shall comply with the following standards:

1. NFPA 70 "National Electrical Code"

2. Applicable NEMA Standards

3. Applicable UL Standards pertaining to raceway system

B. Raceway components shall be listed and labeled by UL, ETL or CSA.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT

A. Rigid metal conduits and couplings shall be full weight, heavy wall steel, galvanized, with threaded connections conforming to the latest editions and revisions of ANSI Standard C-80.1 and UL Standard 6 which supersedes Federal Specification WW-C-581.

B. Fittings shall be steel or cast malleable iron by Chrouse-Hinds, O-Z, T & B, Steel City, Efcor, or equal. O-Z type "AX" or equal fittings with bonding jumpers shall be used in each rigid metal conduit passing across a building expansion joint. Type of fitting shall be properly chosen for the movement anticipated.

C. Insulating bushings shall be used on all rigid metal conduit terminations and shall be O-Z type "B" or equal.

D. T & B Series 141, or equal, locknuts shall be used on both inside and outside on all enclosures.

E. O-Z type "S", or equal, cable supports shall be used in conduit risers as required by the NEC.

2.2 INTERMEDIATE METAL CONDUIT

A. Intermediate Metal Conduit (IMC) and couplings shall be steel, galvanized, with threaded connections, conforming to the latest editions and revisions of Federal Specifications WW-C-581E and Underwriter's Laboratories Standard 1242.

2.3 ELECTRICAL METALLIC TUBING

A. Electrical Metallic Tubing (EMT) shall be galvanized, conforming to the latest editions and revisions of ANSI Standard C80.3, Federal Specifications WW-563, and Underwriter's Laboratories Standard 797.

B. Expansion fitting with bonding jumpers shall be used in each EMT conduit passing across a building expansion joint.

C. Steel concrete-tight (rain-tight in damp and liquid-tight in wet locations) compression type box connections and couplings with nylon insulating throats shall be used.

D. O-Z type "SBT" or equal, insulated bushing shall be used on all EMT conduit terminations not in metal enclosures.

2.4 FLEXIBLE METAL CONDUIT

A. Flexible metal conduit shall be steel, metal strip interlocked construction, zinc-coated, conforming to the latest editions and revisions of Federal Specification WW-C566B and Underwriter's Laboratories Standard for Flexible Steel Conduit, UL1.

B. Liquidtight flexible metal conduit shall be type UL with PVC cover as manufactured by Anamet: trade name - "Sealtite," or "Hydrotite" as manufactured by Eastern Wire and Conduit or equal, conforming to UL360.

C. Fittings and Connectors:

1. Flexible Metallic Conduit: Steel, nylon insulated throat, equal to Crouse-Hinds ACB Series, or Thomas & Betts Tite-bite.

2. Flexible Non-Metallic (Liquidtight): Steel, nylon insulated throat, equal to Crouse-Hinds Liquidator.

3. Die-cast squeeze fittings will not be approved.

2.5 RIGID NONMETALLIC CONDUIT

A. Polyvinyl Chloride (PVC) conduit shall be heavy wall Schedule 40 or Schedule 80 as noted conforming to the latest editions and revisions of Federal Specifications WC-1094, Underwriter's Laboratories Standard UL651, and NEMA Standard TC-2.

B. All joints shall be leakproof, moisture-proof, permanent solvent cement type.

C. Conduit and fittings shall be as manufactured by Carlon, Queen City Plastics or equal.

2.6 RIGID ALUMINUM CONDUIT

A. Aluminum conduit shall not be used.

2.7 CONDUIT BODIES AND FITTINGS

A. All couplings, elbows, cast fittings and conduit bodies shall be made of materials of high quality throughout and shall be a first-grade commercial product, well made and free from mechanical imperfections and defects.

B. Bushings shall be used on all conduits to provide a smooth, well rounded, insulated surface. Bushings shall be metallic with plastic throats. The insulating material shall have a UL temperature rating of 302°F (150°C), it shall be molded-on to the metal and shall become an integral part of the bushing.

C. Erickson or split couplings shall be used in lieu of running threads. Couplings shall be manufactured by O.Z./Gedney, or equal.

D. Entrance seals shall be provided where conduits pass through exterior concrete or masonry walls below grade. The entrance seals shall consist of a hot dip galvanized shell, sealing gland assembly capable of providing a seal around the conduit to withstand fifty feet head of water without leakage. The shell of the seal shall have at least two (2) cast collars at a right angle to the sleeve that is embedded in the concrete. Entrance seals shall be O.Z./Gedney Type WSK, FSK or equal.

E. Conduit hubs shall be malleable iron, zinc plated rain-tight type complete with integral insulated throat, captive O-ring seal and oversize nut. Hubs shall be Myers "Screwtite," O.Z./Gedney "Space Maker," or equal.

2.8 WIREWAYS

A. Electrical wireways shall be of the type, size and number of channels as indicated.

B. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match in form, fit and finish the wireway as required for a complete installation.

2.9 RIGID COATED CONDUIT

A. Prior to application of the coatings, all conduit shall conform to Federal Specification WW-C-581 E, ANSI Standard C80.1 and UL Standard 6.

B. Conduit shall be hot-dip galvanized inside and out prior to coating.

C. Exterior surfaces shall be thoroughly cleaned and treated with an epoxy primer to provide a bond between the zinc and the PVC coating.

D. Adhesion of the PVC coating to coating and fittings shall be greater than the tensile strength of the PVC coating itself.

E. PVC exterior coating shall have a nominal thickness of .040" (1 mm) (40 mils) except where part configuration or application otherwise dictate.

F. Exterior PVC coating on conduit and fittings shall be applied using the fluidized-bed process.

G. A two-part, chemically cured, urethane coating having a nominal thickness of .002" (.05 mm) (2 mils) shall be applied to the interior surfaces of all conduit and feed-through fittings except where prohibited by design.

H. Female coupling and fitting threads, as well as all male threads of conduit, elbows, nipples and fittings shall be protected from corrosion by application of two-part, chemically cured, urethane coating.

I. Each female threaded opening on couplings or fittings shall be protected by an integral PVC sleeve extension formed during the coating process. The sleeve shall extend one pipe diameter or 2" (50 mm) (whichever is less) and have an inside diameter equal to the outside diameter of the uncoated conduit.

J. Form 8 condulets shall be supplied with stainless steel screws with polyester encapsulated heads. Form 7 condulets shall be supplied with stainless steel screws.

K. Finished conduit shall fully conform to the current NEMA Standard RN-1 and shall have a label affixed indicating compliance with UL Standard 6.

L. Interior and exterior coating shall afford sufficient flexibility and elongation to permit field banding without damage.

M. Approved Material: Perma-Cote supreme as manufactured by Perma-Cote Industries.

2.10 IDENTIFICATION

A. Exposed raceways shall be identified at junction and pull boxes and at points not more than 20 feet (6 m) on centers. See Division-26 Section, Basic Electrical Materials and Methods for additional identification requirements.

B. Labels shall indicate the system voltage and/or type of service and shall have an appropriate legend, such as:

1. 480 VOLTS - POWER
2. 480Y/277 VOLTS - LIGHTING
3. 208Y/120 VOLTS - LIGHTING
4. 208Y/120 VOLTS - POWER
5. 120 VOLTS - CONTROL
6. TELEPHONE

C. Labels shall appear in white letters of 1/2 inch (13 mm) minimum height on a black background. Labels shall be installed in accordance with the manufacturer's instructions and sizes shall match the conduits to which they are applied. Labels shall be ordered sufficiently prior to their need so that they will be on hand when required for installation. Failure to allow adequate time for delivery of labels, including special legends, will not be considered valid reason for substitution of labels of a different type.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Exterior locations above grade - rigid metal conduit.

B. Crawl spaces - intermediate metal conduit.

C. Exposed locations, up to 10' - 0" (3 m - 0 mm) AFF - intermediate metal conduit.

D. Exposed locations, above 10' - 0" (3 m - 0 mm) AFF - electrical metallic tubing.

E. Damp or wet locations - rigid metal conduit.

F. Within concrete and masonry exterior walls - intermediate metal conduit.

G. Within concrete floor slabs - rigid nonmetallic Schedule 40 PVC with rigid metal conduit stub-ups.

H. Below slabs on grade - rigid nonmetallic Schedule 40 PVC with rigid metal conduit stub-ups.

I. Conduits for all conductors rated greater than 600V unless encased in concrete - rigid metal conduit.

J. Concealed locations, accessible, dry - electrical metallic tubing.

K. Concealed locations, non-accessible, dry - electrical metallic tubing.

L. Direct buried, exterior, feeders - rigid nonmetallic Schedule 80 PVC

M. Direct buried, exterior, branch circuits (60 amperes or less) - jacketed metal clad cable or rigid nonmetallic Schedule 80 PVC.

N. Above grade connections to substations - rigid metal conduit.

O. Ducts encased in minimum of 2 inch (50 mm) thick concrete - rigid nonmetallic Schedule 40 PVC. All ducts shall have a round exterior with a round bore.

P. Connections to motor terminal boxes, control panels mounted on equipment, dry-type transformers and other vibration producing equipment, dry locations - flexible metal conduit, 18"-36" (450 mm-900 mm) length.

Q. Connections to motor terminal boxes, control panels mounted on equipment, dry-type transformers and other vibration producing equipment, damp and wet locations - liquidtight flexible metal conduit.

R. Recessed lighting fixtures, between fixture and its respective outlet box - flexible metal conduit in lengths as permitted by the NEC, and providing sufficient slack to permit removal of fixture and access to outlet box.

S. Minimum conduit size shall be 3/4" (19 mm).

T. Non-insulating grounding conductors installed within a raceway shall be PVC Schedule 40 (where allowed by Code) or non-ferrous conduit.

3.2 INSTALLATION

A. Unless otherwise noted on the contract drawings, all raceways shall be installed concealed in the floors, ceilings, walls or partitions of the building, and in such a manner as not to impair the integrity of the structure. Unless otherwise specified, raceways may be installed exposed in mechanical rooms, electrical rooms, large storage spaces and in large janitor's closets, pipe shafts, suspended ceiling spaces, and where required for equipment connections. Exposed raceways shall be installed parallel or perpendicular to walls, structural members or intersection of vertical

planes and ceilings, with right angle turns consisting of box-type fittings or symmetrical bends.

1. Exposed conduit in finished areas shall be covered with a 16 gauge steel primed and painted metal cover, secured to an adjacent structure and painted to match adjacent surfaces.

B. The Contractor shall exercise the necessary precautions to prevent water, dirt, plaster or trash in raceways, fittings and boxes during the course of installation; raceways, fittings, or boxes clogged in such manner that cannot be thoroughly cleaned, shall be replaced. All unconnected conduit ends shall be properly capped. Raceways shall be kept at least 12 inches (300 mm) from parallel runs of flues, steam pipes or hot water pipes. Bends and offsets shall be kept to a minimum, and they shall be made without flattening or deformation with approved hickey or bending machine; the radius of the curve of the inner edge of any field bend shall not be less than the value specified in the National Electrical Code. Raceway runs shall not exceed 100 feet (30 m) between outlets; where necessary, even though not indicated on the drawings, box-type fittings or pull boxes shall be installed. Moisture traps shall be avoided as much as possible. Except as noted, raceways shall not be installed horizontally within concrete slabs-on-grade; raceways shall be installed underground, below the slab. Expansion fittings or other approved devices shall be used to provide for expansion and contraction where raceways cross expansion joints.

C. Raceways shall have supports spaced not more than 8 feet (2400 mm) apart, except in vertical risers where 2 inch (50 mm) and larger rigid metal conduit may be supported at intervals not larger than 15 feet (4.5 m). Raceways shall be supported on approved types of zinc-coated wall brackets, clamps, ceiling trapeze hangers, strap hangers, or pipe straps firmly secured in an approved manner. All ends of raceways shall be reamed to remove rough edges. Raceways shall be firmly attached to sheet-metal enclosures NEMA type 1 by means of proper metallic, plastic throated bushings and locknuts; and to sheet-metal enclosures NEMA types 3, 4, 6, 12 or 13, by means of interchangeable, metallic, plastic-throated, raintight hubs. When installing locknuts and bushings, care shall be observed to see that the full number of threads project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be made up sufficiently rigid to draw the bushing into firm electrical and mechanical contact with the box; two locknuts, one inside and one outside, plus the bushing, shall be used where required. Proper electrical continuity shall be established throughout the entire raceway system. An approved compound shall be applied to all field threads before installation.

D. Conduits may be installed in concrete floor slabs with the following limitations:

1. Maximum size - 1-1/4" (32 mm). Conduits larger than 1-1/4" (32 mm) may be installed in concrete floor slabs only with the specific permission of the Architect and Structural Engineer, or as specifically indicated on the drawings, all in accordance with the following limitations.

a. Minimum concrete cover - 1" (25 mm), above and below.

b. Minimum spacing between conduits - 7-1/2" o.c. (188 mm).

c. Maximum conduit outside diameter - 1/3 of slab thickness.

d. Installed between bottom and top reinforcing.

e. Secured to prevent possible change in positions as concrete is poured.

f. Water or damp-proofing integrity of slab is not disturbed.

2. Conduits in close proximity to each other at panelboards, etc., shall be wrapped with wire mesh to prevent cracking of slab.

3. Conduits shall not be installed in post tension slabs.

E. All conduits shall be tested for clearance and smooth joints and then capped immediately after installation by T & B "push penny" plugs, or equal, to prevent entrance of moisture or debris.

F. No wire shall be pulled into conduits until system is complete and the building is thoroughly dry.

G. Conduits to outlets in demountable or dry wall partitions shall be run in ceiling spaces and not in floor slabs.

H. Conduits turning from floor slabs up into partitions shall be totally concealed.

I. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc., shall be suitably sealed with "Duxseal" by Johns Manville or sealing fittings to prevent accumulation of condensation.

J. Conduits and sleeves penetrating floor slabs and fire-rated partitions shall have the chopped out space between the outer wall of the piping and the concrete sealed with fire resistant material listed by UL for use in fire

rated floor and partition systems. Sleeves penetrating floor slabs shall extend 1-1/2" (40 mm) above the finished floor.

K. Conduits less than 12" (300 mm) in length connecting outlets of adjoining rooms shall be sealed with "Duxseal" by Johns Manville to prevent noise transmission between rooms.

L. Pull wires shall be installed in all empty conduits. Use No. 14 AWG monofilament plastic line having not less than 200-lb. (1380 kPa) tensile strength. A minimum of 12 inches (300 mm) of slack shall be provided at each end of the pull wire.

3.3 UNDERGROUND DUCTS

A. Underground electrical and communication ducts shall be located a minimum of 6 feet (1800 mm) away from steam and hot water lines except at crossings where a 1 foot (300 mm) separation shall be permitted.

B. Unless otherwise noted or specified, underground raceways shall be installed 24 inches (600 mm), minimum, below grade for 600 volts, or less, and 36 inches (900 mm), minimum, below grade for higher voltages. The bottom of the trench shall be even and firm and shall be free of rocks and sharp objects; the trench shall be backfilled with clean, rock-free soil, in 6-inch (150 mm) layers and each layer shall be compacted before addition of subsequent layers. The surface (turf, sidewalk, roadway, etc.) shall be restored to its original condition.

C. Ducts shall be installed below the frost line at the project site location.

D. Direct buried ducts shall be covered with not less than a 6-inch (150 mm) layer of sand before being backfilled.

E. Ducts for electrical power circuits shall be completely isolated from ducts for communication circuits. Separate access points and termination points shall be provided. Ducts for electrical power circuits and ducts for communication circuits may share the same trench when such an arrangement is approved by the appropriate utility or contractor.

F. A minimum 3 inch (75 mm) clearance shall be maintained between raceways in multiple raceway installations. Rigid PVC spacers shall securely support and maintain uniform spacing of the duct assembly. A minimum of 3 inches (75 mm) shall be maintained between the duct assembly and the bottom of the trench during backfilling. Spacers shall be installed at intervals not exceeding 4 feet (1200 mm). Provide non-

ferrous tie wires to prevent displacement of the ducts. Tie wires shall not act as substitutes for spacers.

G. Ducts shall be sloped away from building and equipment entrances. Pitch shall be not less than 4 inches (100 mm) in 100 feet (30 m). Curve sections in duct lines shall consist of long sweep bends. The use of manufactured bends shall be limited to building entrances and stub-ups to equipment.

H. Only standard 2,500 psi (17,237 kPa) ready-mix concrete with air entrainment and pea gravel will be approved for encasement.

I. Underground conduit stub-ups to equipment inside of buildings shall be galvanized rigid steel. Stub-ups to equipment mounted on outdoor concrete slabs shall be galvanized rigid steel. Install insulated grounding bushings on the terminations. The steel stub-ups shall be coupled to the ducts with suitable adapters.

J. Ducts shall be kept clean of earth, sand or gravel during construction, and sealed with tapered plugs upon completion of each portion of the work. Upon completion of the duct bank installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of soft earth, sand, or foreign material left in the duct line. The mandrel shall be not less than 12 inches (300 mm) long, and shall have a diameter 1/2 inch (13 mm) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be slightly larger than the diameter of the duct.

K. Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.

L. Duct lines shall terminate at window openings in manhole walls as shown on the Drawings. All ducts shall be fitted with end bells.

M. Couple the ducts with proper couplings. Couplings shall be staggered in rows and layers to insure maximum strength and rigidity of the duct bank.

N. Where new ducts, conduits, and concrete envelopes are to be joined to existing manholes, handholes, ducts, conduits, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes, where applicable, to insure smooth durable transitions.

O. Underground cables, raceways and ducts shall have a continuous strip of heavy gage plastic approximately 6 inches (150 mm) wide installed 12 inches (300 mm) below the surface over ducts or conduits before

backfilling trenches. Plastic strip shall be printed with the words "Caution - Buried Electrical Line Below," or a similar phrase approved by the Engineer.

P. All underground installations intended for local power company service cables shall conform to the latest requirements of the local power company. The Contractor is responsible for obtaining a copy of the aforementioned power company handbook and is also responsible for full compliance. The power company requirements shall take precedence over any conflicting information provided under this contract.

3.4 EXCAVATION AND BACKFILLING

A. The Contractor shall provide necessary excavation and backfill for the installation of electrical work. The Contractor shall coordinate work with other trades to avoid interference and minimize trenching. Establish all lines and grades required for the proper location of the work and be responsible for the correctness thereof. Verify location and check elevations of all existing utilities before starting work.

B. Provide guard rails and other necessary safeguards around excavation. Provide shoring, bracing, etc. to protect work, safety of personnel, and existing utilities and underground work. Provide protection against injury of adjacent property. Keep excavation drained and pumped out. Do not permit debris and other materials to enter drains and piping.

C. Excavate to depth and width required for proper installation of electrical work with minimum clearance of 8 inches (200 mm) on each side and minimum overdepth of 6 inches (150 mm). Excavated materials not required or suitable for backfill shall be removed from the site. Where excess excavation is made, backfill to required level with concrete or crusher run (CR6).

D. Provide bedding of firmly compacted sand, providing uniform support, to centerline of conduit, duct, ductbank or cable. Minimum depth of sand below conduit, duct, ductbank, or cable shall be three inches (75 mm). Deposit initial layer of backfill, six inches (150 mm) deep, over conduit, duct, ductbank or cable and tamp. Deposit individual layers of backfill in 6 inch (150 mm) layers and tamp. Backfill material under roadway, structures, and equipment, etc. shall be compacted sand. Backfill material shall be free of organic matter, cinders, frozen earth or rock larger than 4 inches (100 mm) in any dimension.

E. Repair and/or replace any curbs, roads, walks fences, utilities or structures disturbed as a result of the work. Seed or sod all areas disturbed as a result of the work.

3.5 CLEANING

A. Inspect all raceways; clear all blockages; and remove all burrs, dirt and construction debris from raceways before installing conductors.

END OF SECTION

SECTION 26 0534 - BOXES, FITTINGS AND CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

1.2 SUMMARY

A. Provide and install outlet boxes, pull and junction boxes, cabinets and enclosures as required by the Drawings and as required by field conditions for a complete installation in accordance with the National Electrical Code.

1.3 SUBMITTALS

A. Provide product data for all cabinets and enclosures.

1.4 QUALITY ASSURANCE

A. All items provided under this Section shall be listed and labeled by UL or a Nationally Recognized Testing Laboratory (NRTL).

B. The components and installation shall comply with NFPA 70 "National Electrical Code."

C. Enclosures shall comply with NEMA Standard 250, "Enclosures for Electrical Equipment."

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES

A. Outlet boxes shall conform to UL 514A, "Metallic Outlet Boxes, Electrical," and fittings shall conform to UL 514B, "Fittings for Conduit and Outlet Boxes."

B. Outlet boxes for indoor and dry locations shall be minimum 4" (100 mm)

square or octagonal, 2-1/8 inch (53 mm) deep, zinc-coated sheet steel with stamped knockouts, threaded screw holes and mounting accessories suitable for each location and application. Straps, cable clamps, exterior rings and fixture studs shall be provided as required.

C. Outlet boxes for outdoor or wet locations shall be minimum 4" (100 mm) square copper-free aluminum cast boxes with threaded raceway entries, threaded screw holes and mounting accessories suitable for each location and application. Straps, mounting feet, closure plugs, cable clamps, exterior rings and fixture studs shall be provided as required.

D. Outlet boxes in concrete construction shall be of sufficient depth to keep conduits a minimum of 1" (25 mm) from the wall surface.

E. No "thru-wall" boxes shall be used in partitions.

F. Steel floor boxes shall be sheet steel construction, concrete tight, fully adjustable, with stamped knockouts, adjusting rings, and brass floor plates.

G. Outlet boxes in masonry partitions shall have square corners with no mounting tabs and shall be of sufficient depth to suit the block or brick construction.

2.2 NONMETALLIC OUTLET BOXES

A. Nonmetallic outlet boxes shall not be used.

2.3 ACCESS FLOOR BOXES

A. Access floor boxes shall be fabricated from minimum 14 gauge galvanized steel. Boxes shall have a reinforced hinged cover with flange suitable for accepting carpet, tile or high pressure laminate. The box shall provide an unobstructed enclosure for power receptacles, data and communication outlets.

B. Access floor boxes shall be provided with two (2) duplex receptacles, NEMA 5-20R, and two (2) duplex data outlets.

C. Access floor boxes shall be removable from the access floor without disturbing floor panels. Access to box wiring space shall be through a removable cover on the bottom or back of the box. The top cover shall be capable of being closed with cords and cables exiting from the box. Cords and cables shall be protected from the closed cover by a retractable cable exit. When the cover is closed and no cords or cables

are in place there shall be no obstructions above the floor.

2.4 PULL AND JUNCTION BOXES

A. Pull and junction boxes over 100 cubic inches (.0016 m3) in volume shall comply with UL Standard 50, "Electrical Cabinets and Boxes."

B. Boxes shall have screwed or bolted-on covers of the same material as the box and shall be sized to accommodate the application and the site conditions.

C. Sheet steel boxes shall have welded seams and shall have structural bracing where required to provide a rigid assembly.

D. All boxes for concealed work shall be constructed of minimum 12 gauge galvanized sheet steel with welded seams and shall be provided with mounting brackets. Integral bracing shall be provided where required to provide a rigid assembly.

E. All boxes installed in wet locations or on the building exterior shall be constructed from galvanized sheet steel with gasketed covers.

2.5 CABINETS

A. Cabinets shall conform to UL Standard 50, "Electrical Cabinets and Boxes."

B. Backboxes shall be constructed from galvanized sheet steel, and fronts and doors shall be constructed from rolled sheet steel. Cabinets shall be NEMA 1 except as otherwise noted. Cabinets shall consist of a box and a one-piece frame front with a hinged door. Concealed fasteners shall secure front to box and provide adjustment to permit alignment of front and box.

C. Hinges shall be flush, shall not be more than 6" (150 mm) from the top and bottom of the door, and shall be no more than 24" (600 mm) apart. Doors greater than 48" (1200 mm) in height shall have 3-point latching mechanism.

D. Surface mounted cabinets shall have fronts of the same height and width as the box. Flush mounted cabinets shall have fronts which extend 3/4" (19 mm) beyond box in all directions.

E. Double doors shall be provided for cabinets wider than 24" (600 mm).

F. Doors shall have combination spring catch and key lock. All locks for cabinets of a common system shall be keyed alike.

PART 3 - EXECUTION

3.1 OUTLET BOXES

A. Outlet boxes shall be firmly secured in place, plumb and level. Outlet boxes installed in suspended ceilings shall not be supported from the ceiling system. Outlet boxes for like devices shall have a uniform mounting height unless specifically noted otherwise.

B. Outlet boxes over windows and doors shall be installed 7'-6" (2250 mm) above the finished floor, centered over the door or window unless otherwise noted.

C. Outlet boxes shall be 6"-12" (150 mm-300 mm) from the strike side of the door frame when installed adjacent to a door opening.

D. Outlet boxes at fixed work surfaces and counter tops shall be installed with the center of the box 6" (150 mm) above the work surface or counter surface unless otherwise noted.

E. Covers shall be installed on all outlet boxes.

F. Outlet boxes for wall mounted video equipment shall be installed with the center of the box 80" (2000 mm) above the finished floor or 6" (150 mm) below the finished ceiling, whichever is lower.

G. Outlet boxes for electric water coolers shall be wall mounted and shall not be visible after the water cooler is installed. Mounting height shall be coordinated in the field.

H. Coordinate outlet box locations with baseboard heating units. Contractor shall adjust box locations where necessary to accommodate installation and listing requirements of baseboard heating units. Advise Owner/Engineer of any necessary adjustments. Outlet boxes shall be installed above hydronic baseboard heat and below electric baseboard heat.

I. Outlet box mounting heights are as indicated. Mounting heights shall be to the center line of the box.

3.2 PULL AND JUNCTION BOXES

A. Pull and junction boxes shall be no smaller than 8 inches (200 mm) square by 4 inches (100 mm) deep.

B. Boxes shall be the minimum size as required by the National Electrical

Code or larger as indicated on the Drawings.

C. Junction and pull boxes shall be furnished and installed where indicated on the Drawings or where required by the NEC.

D. Boxes for communication, data and signaling systems shall be 50 percent larger than the size required by the NEC and shall be located to permit ready access for installation of future raceways and conductors.

3.3 CABINETS AND ENCLOSURES

A. Fronts of cabinets and enclosures shall be mounted straight and plumb with building surfaces.

B. Cabinets and enclosures 68" (1700 mm) or less in height shall be installed with the top of the cabinet or enclosure 72" (1800 mm) above the finished floor. All cabinets and enclosures shall be installed in accordance with the NEC.

C. Cabinets and enclosures installed adjacent to one another shall be installed with the tops of the cabinets and enclosures at the same height.

D. Cabinets and enclosures in finished areas shall be flush with the walls. Cabinets and enclosures in mechanical and electrical rooms shall be surface mounted unless otherwise noted.

3.4 GROUNDING

A. All metallic boxes, cabinets and enclosures shall be effectively grounded in accordance with Article 250 of the NEC.

B. Provide a grounding terminal in the interior of all boxes, cabinets and enclosures.

3.5 CLEANING

A. After installation, clean and repair all boxes, cabinets and enclosures. Galvanized finishes shall be repaired using a zinc-rich paint as recommended by the manufacturer. Painted finishes shall be repaired using a matching paint from the manufacturer.

END OF SECTION

SECTION 26 0543 - UNDERGROUND ELECTRICAL STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this section.

1.2 SUMMARY

A. The Contractor shall furnish and install all manholes, handholes, and all accessories and materials required for a complete underground distribution system as indicated on the Drawings.

B. The Contractor shall coordinate all work with the appropriate utilities and with the Owner. No work shall be performed until a written schedule is provided to the Owner, and written approval of the schedule is received from the Owner.

1.3 SUBMITTALS

A. Provide manufacturer's product data for all fittings, precast manholes, handholes, and all manufactured accessories.

B. Provide Shop drawings for all cast-in-place manholes, handholes, and all field-fabricated supports, brackets and accessories.

C. Provide site plans and profiles of manholes, handholes, and ducts.

1.4 QUALITY ASSURANCE

A. All underground manholes and handholes and the installation of underground manholes and handholes and components shall comply with the following standards:

1. NFPA 70, "National Electrical Code"

2. National Electrical Contractors Association's "Standard of Installation"

3. Applicable IEEE/ANSI Standards

PART 2 - PRODUCTS

2.1 PRECAST MANHOLES AND HANDHOLES

A. Manholes and handholes, shall be precast concrete, with dimensions indicated on the Drawings.

B. Manholes and handholes for electrical power circuits shall have a sleeve for a ground rod.

C. Covers shall be round and shall provide a minimum 36 inch (900 mm) opening. Covers shall identify the type of service: "Electric" or "Communication". Covers shall have a recessed handle or other provisions for lifting.

D. Pulling-in irons shall be provided opposite each duct opening and where there are provisions for future duct entrances.

E. Cable racks shall be provided to properly support both ends of cable joints and splices. A minimum of two cable racks shall be provided on each wall except where racks would interfere with duct entrances. Cable racks shall be spaced 36-48 inches (900-1200 mm) for power cables, 30 inches (750 mm) for communication cables.

F. A sump pit and cover shall be provided. The sump shall have a 12" (300 mm) opening and 12" (300 mm) depth. The bottom of manholes and handholes shall be sloped to drain into the sump.

G. End bells shall be provided for all duct entrances.

H. When installed by the electric utility company, all underground manhole and handhole installations intended for utility service cables shall conform to the requirements of the latest version of the electric utility company's guidelines. The Contractor is responsible for obtaining a copy of the aforementioned guidelines and is also responsible for full compliance. The electric utility company requirements shall take precedence over any conflicting information provided under this contract.

2.2 POLYMER CONCRETE UNDERGROUND ENCLOSURES

A. Enclosures shall be polymer concrete. The enclosures shall be suitable for direct buried applications in soil, concrete embedment, or asphalt embedment.

B. The enclosures shall be concrete/cement gray in color, unless otherwise

specified.

C. The enclosure dimensions shall be as indicated on the Drawings. The enclosure shall have an open bottom. Knockouts shall be notched to allow for a smooth edge upon removal.

D. The cover shall have a logo that reads "ELECTRIC" or "COMMUNICATION". The cover shall have two lifting eyes/pull slots with the following dimensions – 1/2" x 4" with a ¼" center pin. The cover's surface shall be skid resistant and have a minimum coefficient of friction of 0.50, as specified in current ANSI/SCTE 77. The cover shall have two locking bolt slots, and two 3/8" – 16 UNC hex head bolts to secure the cover into the box.

E. The enclosures (box and cover) shall comply with all of the environmental tests as per current ANSI/SCTE 77.

F. The enclosures (box and cover) shall be current ANSI/SCTE 77 Tier 22 and shall be UL Listed to 66WF and tested to the full ANSI standard.

G. Basis of Design is Hubbell enclosures such as Quazite or approved equal.

PART 3 - EXECUTION

3.1 MANHOLES AND HANDHOLES

A. Manholes and handholes, shall be installed by or under the supervision of the manufacturer, in accordance with the manufacturer's written instructions.

B. Brick collars shall be used to bring the cover of manholes and handholes to the finished grade.

C. Manholes and handholes shall be located in accordance with the Drawings, and shall be set in place on a gravel bed to ensure a plumb installation.

3.2 POLYMER CONCRETE UNDERGROUND ENCLOSURES

A. Provide excavation and backfilling include minimum 6" gravel base under the enclosure assembly with the gravel 3" to 4" wider than the sides of the enclosure. (Internal Bracing may be warranted for any manufacturer's underground enclosure if 95% compaction is required or if heavy vehicles are going to be present during construction and/or throughout the life of the enclosure. See manufacturer recommended

practices and instruction including applicable sizes that would require internal bracing).

END OF SECTION

SECTION 26 0549 - SEISMIC AND WIND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section specifies the minimum requirements for restraining Electrical systems and equipment.

B. This Section includes the following:

1. Restrained elastomeric isolation mounts
2. Restrained spring isolators
3. Restrained vibration isolation roof curb/rail assemblies
4. Restraint snubbers
5. Restraining braces and cables
6. Flexible connectors for restraint applications

1.3 APPLICABLE STANDARDS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

D. ASCE-7: Minimum Design Loads for Buildings and Other Structures.

1.4 PERFORMANCE REQUIREMENTS

A. All Electrical components shall be mounted to resist seismic loads per IBC

requirements.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: See Structural Drawing General Notes.

2. Assigned Seismic Building Occupancy Category as Defined in the IBC: See Structural Drawing General Notes.

a. Component Importance Factor: See Schedule in Part 3 of this Section.

b. Component Response Modification Factor: Per ASCE-7 Table 13.6-1.

c. Component Amplification Factor: Per ASCE-7 Table 13.6-1.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Structural Drawing General Notes.

4. Design Spectral Response Acceleration at 1.0-Second Period: See Structural Drawing General Notes.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of restraint component used.

B. Delegated-Design Submittal: For restraint details indicated to comply with performance requirements and design criteria, include project specific load analysis data signed and sealed by the qualified professional engineer responsible for their preparations.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation and seismic and wind forces required to select restraints.

2. Seismic and Wind Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and/or wind restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic and/or wind load events. Indicate association with vibration isolation devices.

c. Coordinate seismic and/or wind restraint details required for equipment mounted outdoors. Comply with requirements in other Division-26 Sections for equipment and components mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES showing maximum ratings for concrete anchors (tests or calculations).

C. Coordination Drawings: Show coordination of seismic and/or wind load bracing for Electrical conduit and equipment with other systems and equipment in the vicinity, including other supports and seismic and/or wind restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Field quality-control inspection reports.

1.6 QUALITY ASSURANCE

A. Comply with seismic and wind restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Restraint devices shall have horizontal and vertical load analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum restraint ratings. Submittals based on independent testing and/or calculations are acceptable. Calculations (including combining shear and tensile loads) to support restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements of this section, provide products by Kinetics Noise Control or equivalent.

B. Provide appropriate product(s) from those listed below to meet the requirements of restraining or restraining/vibration isolating electrical components.

2.2 COMBINATION RESTRAINT/VIBRATION ISOLATION DEVICES FOR NON-CURB MOUNTED EQUIPMENT

A. Restrained Rubber/Neoprene Mounts, Model RQ: All-directional restrained mountings.

1. Materials: Cast-ductile-iron or welded steel housing containing oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

B. Restrained Spring Isolators, Model FHS: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

5. Housing: Factory drilled for bolting to structure

C. Restrained Spring Isolators, Models FLS / FLSS: Freestanding, steel, open-spring isolators with limit-stop/restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

D. Side Mount Restrained Spring Isolator, Model FMS: Side mount spring isolator with integral restraint snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional restraint.

2. Base: Factory drilled for bolting to structure.

3. Equipment Mount: Factory drilled for bolting to the equipment.

4. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

5. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

2.3 COMBINATION RESTRAINT/VIBRATION ISOLATION DEVICES FOR CURB MOUNTED EQUIPMENT

A. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb and rail designed to resiliently support equipment and to withstand seismic and wind forces.

1. All of the components within the final product and including the final product are to be manufactured within the United States of America.

2. Complete curb and isolation assembly shall be stamped by a Professional Engineer licensed in the jurisdiction of the project.

3. Provide sloped and/or extended height curb assemblies as necessary to coordinate with roof slope and buildup.

B. Sheet Metal Restraint/Spring Isolation Curbs, Model KSCR: Upper frame

shall consist of extruded aluminum top rail, shall provide continuous support for equipment, and shall be captive to resiliently resist seismic and wind forces. Lower support assembly to be constructed out of formed heavy gage sheet metal, shall have a means for attaching to building structure, contain a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches (50 mm) of rigid, glass-fiber insulation on inside of assembly.

C. Structural Steel Restraint/Spring Isolation Curbs, Model ESR: Upper frame shall consist of a structural steel C channel to provide continuous support for the equipment and provide a place of attachment to the equipment. The lower frame shall be constructed from structural steel and shall provide adequate support to resist seismic and wind loads. The springs shall be adjustable, restrained with 1/4-inch (6-mm) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic/wind restraint.

    a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.

    b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

    c. Minimum Additional Travel: 50 percent of the required deflection at rated load.

    d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

    e. Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.

2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

    a. Resilient Material: Oil- and water-resistant hermetically sealed compressed fiberglass.

3. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

4. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

5. Extend height of curb as necessary to allow for spring isolator access after roof buildup is installed.

2.4 FLEXIBLE CONNECTORS TO ACCOMMODATE DIFFERENTIAL MOTION

A. Basis-of-Design Product: Subject to compliance with requirements of this section, provide flexible connectors to accommodate differential motion by Engineered Flexible Products (EFP) or equivalent.

B. General Requirements for Flexible Connectors to Accommodate Differential Motion:

1. Flexible connectors shall be chosen to accommodate differential motion caused where conduit crosses seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

2. Flexible connectors shall not introduce any thrust loads into the distribution system and shall contain a welded on braid.

3. Flexible connectors shall be constructed of stainless steel braid with carbon steel end fittings and/or bronze braid with copper end fittings.

4. Flexible connectors shall be V-shaped and capable of accommodating up to 4 inches (100 mm) of differential motion from centerline.

5. Flexible connectors shall be supplied by restraint supplier as part of restraint system.

2.5 SEISMIC AND WIND RESTRAINT DEVICES

A. General Requirements for Concrete Anchoring Components:

1. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

2. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be per IBC.

B. Snubbers, Model KSMS / KSMG: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismically rated, with an ICC-ES report.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

C. Cable Restraint Kit, Model KSCU, KSWC, or KSCC: A pair of pre-stretched steel cables with end connections made of steel assemblies with thimbles (if vibration isolation is needed), brackets, swivels, and bolts designed for restraining cable service.

1. Kit shall include all hardware required for connection to the equipment/system.

2. Kit shall include a tool-less connector to avoid cable cutting and saddle clamps where possible.

3. Cables shall have one end pre-swaged from the manufacturer.

4. Cable size shall be 2 mm, 3 mm, 5 mm, and/or 6 mm in diameter depending on calculated design load.

5. Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.

D. Hanger Rod Stiffener, Model KHRC: Clamp for attaching reinforcing steel angle to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

G. Resilient Isolation Washers and Bushings, Model TG: One-piece, molded,

oil- and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts, Model KCAB/KCCAB/KUAB: Select anchor bolts with strength required for anchorage and as tested according to ASTM E 488. Minimum length of anchor to be eight times diameter.

1. Anchor bolts to be zinc-coated steel for interior applications and stainless steel for exterior applications.

2. For equipment that is rigidly mounted and has 10 horsepower or less use drilled-in and stud-wedge or female-wedge type anchor.

3. For equipment that is rigidly mounted and has greater than 10 horsepower, use undercut anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved by Professional Engineer of record for the project.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on delegated design drawings to receive them and where required to prevent buckling of hanger rods due to seismic and/or wind load forces.

C. Strength of Support and Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic and/or wind loads within specified loading limits.

3.3 SEISMIC AND WIND RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in architectural specifications for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install restraint snubbers on equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Combination restraint/vibration isolation devices may be installed in lieu of separate vibration isolators and restraint snubbers if they conform to all requirements of this specification.

3. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

4. Install restraint devices using methods provided by restraint supplier and required submittals for component.

C. Electrical Restraints:

1. Comply with requirements of restraint system manufacturer.

2. Restrain all electrical equipment and distribution systems except that listed below:

a. Single supported conduit with a trade size of 2.5" or less.

b. Trapeze supported conduit, cable trays, bus ducts, etc. whose total weight is less than 10 lbs./ft.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install restraint devices using methods approved by the restraint supplier required by the submittals for the component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges/webs of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in conduit where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

B. Flexible connections to be supplied by restraint supplier.

3.5 FIELD QUALITY CONTROL

A. Inspections:

1. Verify isolator restraint clearance.

2. Verify snubber minimum clearances.

3. Verify ten percent of all cable restraints to ensure the angle of the restraints is installed properly.

4. Verify ten percent of all hanger rod locations where hanger rod stiffening is indicated in coordination drawings to ensure hanger rod stiffeners are installed properly.

3.6 ADJUSTING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

B. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 0573 - COORDINATION STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall engage the services of a qualified professional engineer to perform a short circuit and protective device coordination study and an arc flash hazard analysis. The Contractor is responsible for providing all pertinent information required by the preparers to complete the study. The study shall be performed in strict accordance with these specifications.

B. The study shall include all portions of the electrical distribution system from the utility overcurrent device to the 208Y/120 volt branch circuit panelboards.

PART 2 - PRODUCTS

2.1 SHORT CIRCUIT STUDY

A. The Contractor shall provide a short circuit study for the electrical distribution system. The study shall include the calculation of three phase bolted fault values and phase to ground fault values at every point of application of a protective device on the system. Momentary and interrupting duty values shall be calculated.

B. Obtain a letter from the utility company indicating what the available fault current and X/R ratios are at the service entrance. Provide the letter in an appendix of the report.

C. The short circuit calculations shall be performed by a computer program. Provide a computer generated single line diagram showing calculated and rated fault levels for each piece of electrical equipment.

D. The short circuit study report must include a complete index of fault bus identifications. A system diagram indicating system configuration and the fault bus locations shall be provided in the study.

E. Provide a complete printout of the results of the calculations.

F. Momentary duty fault values shall be tabulated for both three phase and phase to ground faults including: bus identification, bus L-L voltage,

symmetrical fault current values, symmetrical fault kVA values, and X/R ratio at each fault bus.

G. Interrupting duty fault values shall be tabulated for both three phase and phase to ground faults including: bus values, symmetrical fault kVA values, X/R ratio at each fault bus, asymmetry factor at each fault bus, and the associated asymmetrical fault value at the bus.

H. Manufacturer's published interrupting/withstand capabilities shall be compared to calculated fault current values to determine acceptability of each protective device installed on the system. A tabulation shall be provided detailing the comparison.

I. The short circuit study shall report any deficiencies in interrupting capabilities and include recommendations for correcting such deficiencies.

2.2 PROTECTIVE DEVICE COORDINATION STUDY

A. The Contractor shall provide a protective device coordination study for all protective devices installed on the electrical distribution system.

B. The coordination study shall begin with the first upstream utility protective device and continue down through the distribution system to the first device on each feeder which does not have adjustable trip characteristics.

C. Time-current coordination curve sheets shall be developed on log-log paper utilizing manufacturer's published time-current characteristics. Key coordination elements shall be plotted to demonstrate the level of coordination provided.

D. Transformer damage characteristics as specified in American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI and IEEE) guidelines and inrush points shall be plotted to demonstrate the level of protection provided. Cable insulation withstand curves shall also be plotted to demonstrate protection provided.

E. Each curve sheet shall have a single line diagram indicating the portion of the system being plotted.

F. Each curve sheet shall be accompanied by a detailed narrative explaining the coordination provided, and any compromises made between protection and selectivity.

G. The coordination study report shall provide complete tabulations of all

protective devices, ratings and settings. Recommendations shall be provided to improve coordination where necessary.

2.3 ARC FLASH HAZARD ANALYSIS

A. Provide arc flash hazard calculations for all electrical distribution equipment identified in NEC Article 110.16, Flash Protection.

B. Provide arc flash hazard calculations per IEEE-1584. Calculations shall provide the flash protection boundary (ft.), arc flash hazard category and the required personnel protective equipment (PPE) for all electrical distribution system equipment included in the Arc Flash Hazard Analysis. Also provide incident energy level as calculated in analysis.

C. Provide an arc flash hazard warning label on all electrical distribution system equipment included in the Arc Flash Hazard Analysis. The label shall comply with ANSI Z535.4-1998, Product Safety Signs and Labels. The label shall include, but not be limited to, the flash protection boundary, flash hazard category, and required PPE.

D. Provide painted arc flash protection boundary line on floor in front of each piece of equipment involved in the arc flash hazard analysis. Painted line shall be minimum 4" wide with a painted stencil label stating "Arc Flash Protection Boundary". Color of painted line to be approved by the Owner.

PART 3 - EXECUTION

3.1 REPORT

A. The short circuit and coordination study shall be completed prior to releasing for manufacture of all switchboards, fused switches, panelboards, circuit breakers and other equipment with overcurrent protection.

B. Six (6) copies of a bound report shall be submitted for review and approval at the completion of the short circuit and coordination study. The report shall contain all of the items required by these specifications. The report must be submitted prior to the delivery of any distribution equipment submittals. Submittal reviews of distribution equipment shall be withheld until the report is received, reviewed, and approved.

C. Time-current coordination curve sheets may be reduced to 8-1/2 x 11 size for inclusion in the report. However, full size curve sheets shall be provided,

not necessarily bound, with each copy of the report.

D. The Contractor shall warrant that errors and omissions in the study or report shall be corrected without charge to the Owner when so found within twelve (12) months from acceptance of the first report.

E. Copies of the approved study shall be included in the manuals specified in Division-26 Section, "Basic Electrical Materials and Methods."

END OF SECTION

SECTION 26 0943 - LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. The following specifications detail the minimum performance and related criteria for a lighting control system proposed for this project.

1.2 RELATED SECTIONS

A. Division-26 Section, Wiring Devices.

1.3 SYSTEM DESCRIPTION

A. System shall consist of factory pre-assembled dimming and switching panels, centralized preset lighting control(s), line voltage and low voltage wallstations and/or control interfaces, and solid-state high frequency fluorescent dimming ballasts (where applicable). Additional items may also be required and are described herein and/or shown on the drawings.

1.4 SUBMITTALS

A. Shall include a load schedule which indicates the actual connected load and load type per circuit, circuits and their respective control zones, circuits that are on emergency (if applicable), and the capacity, phase, and corresponding circuit numbers (per the electrical drawings).

B. Shall include a complete schematic of the system.

C. Shall include catalog cut sheets with performance specifications including historical testing data demonstrating complete compliance to all of the specifications herein.

D. Shall include written certification of compatibility of all lighting controls.

E. Shall include all exceptions taken to the specification.

F. Shall be submitted for approval a minimum of ten (10) business days prior to bid date for all materials other than those specified herein.

G. Manufacturer shall provide any additional information or factory

demonstrations as required by the specifier to demonstrate conformance with Part 2 of this specification. All demonstrations are to be at a location, time and in a manner chosen by the specifier.

1.5 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of ten (10) years continuous experience in the manufacturing of lighting controls.

B. Lighting control system shall be UL listed specifically for the required loads Manufacturer shall provide evidence of compliance on request.

1.6 PROJECT/SITE CONDITIONS

A. Lighting control system shall operate in an ambient temperature range of 0˚C (32˚F) to 40˚C (104˚F) and 90% non-condensing relative humidity without the requirement of a regularly scheduled maintenance program for air filtration components.

1.7 WARRANTY

A. Manufacturer shall provide a full two (2) year warranty. The warranty shall cover 100% of the cost to repair or replace any parts required over the first two (2) years, which are directly attributable to the manufacturer.

1.8 COMMISSIONING

A. The contractor shall provide the manufacturer with ten (10) working days notice of the scheduled commissioning date.

B. Upon completion of the installation, the system shall be completely commissioned by a factory-employed engineer. The check-out will be performed after all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. The factory-employed engineer shall demonstrate and educate the owner's representative(s) on the system capabilities, operation and maintenance.

C. Manufacturer shall offer extended warranty based upon successful factory commissioning.

PART 2 - PRODUCTS

2.1 WALLBOX PRESET CONTROLS, DIMMERS, SWITCHES AND WIRING DEVICES

A. Refer to Division-26 Section, Wiring Devices for details.

2.2 OCCUPANT SENSORS

A. All occupant sensors shall be provided by one manufacturer as part of the lighting control system.

B. All occupant sensors shall be capable of central control by the lighting control system.

C. Occupant sensors shall incorporate ultrasonic motion sensing technology.

D. Occupant sensors shall incorporate adjustable sensitivity to cover various room sizes.

E. Wall Switch Occupant Sensors:

1. Wall switch occupant sensors shall be capable of controlling 6.7 amps at 120 volts or 4.3 amps at 277 volts.

2. Wall switch occupant sensors shall detect minor hand motion in rooms up to 300 square feet.

3. Wall switch occupant sensors shall provide the option for automatic or manual on and off control.

F. Ceiling-Mounted Occupant Sensors:

1. Ceiling-mounted occupant sensors shall be capable of controlling 16 amps at 120 volts or 277 volts with power-pack relay.

2. One-way ceiling-mounted occupant sensors shall detect minor hand motion in rooms up to 575 square feet. Two-way ceiling-mounted occupant sensors shall detect minor hand motion in rooms up to 1345 square feet.

3. Ceiling-mounted occupant sensors shall provide automatic on and off control.

4. Ceiling-mounted occupant sensors shall have Teflon insulated wires that are fire-rated for mounting in ceiling plenums.

2.3 POWER PANELS

A. Panels shall be UL listed or CSA, NOM or CE approved (where appropriate). Panels shall be wall or floor mounted NEMA grade, gauge as required by UL508. Contractor shall reinforce wall as required for wall-mounted panels.

B. Panels shall be completely pre-assembled and factory tested by the manufacturer. The contractor shall be required to provide input feed wiring, load wiring, and control wiring. No other wiring or assembly by the contractor shall be permitted. All input feed, load, and control terminals shall be front accessible without the need to remove dimmer assemblies or other components.

C. Unless the panel is a dedicated feed-through switching panel or otherwise indicated, panels shall contain branch circuit protection for each dimming assembly. Branch circuit breakers shall have the following performance characteristics:

1. UL listed under UL 489 or meet IEC 60898 as a molded case circuit breaker for use on lighting circuits.

2. Contain a visual trip indicator and shall be rated at 10,000 AIC (120V), 6000 AIC (230V) and 14,000 AIC (277V), unless otherwise noted.

3. Thermal-magnetic in construction for both overload and dead short protection. The use of fully magnetic breakers shall not be acceptable, even when used in conjunction with individual dimmer thermal cutouts.

4. Replaceable without moving dimmer assemblies or other components of the panel.

5. For 120V and 277V, shall be switching duty (SWD) rated so that loads can be switched off via the breakers.

D. Activation of a circuit protection device shall affect only the single dimmer that it is wired to protect.

E. Panels shall be equipped with an electronic BYPASS feature which electronically switches lighting loads to full light output from any level by toggling the individual branch circuit breakers (for individual circuits) or main breaker (for all circuits) when there is no intensity data available from the control system.

F. Panels which allow the dimmers to be loaded to greater than 80% of the

wiring ampacity as specified by NEC shall not be acceptable.

G. Panels requiring the neutral feeder to be sized larger than any individual phase feeder shall not be acceptable.

H. Panels shall be shipped with each dimmer in a mechanical BYPASS position via a jumper bar inserted between the input and load terminals to allow dimming panel to be used as a temporary lighting panel with no threat to the dimmer. These jumpers shall carry the complete load current and shall be reusable at any time.

I. Panels shall be capable of maintaining dimmers at current light levels in the event of a control failure. Systems that fail to off during a control failure are not acceptable.

J. Panels shall be passively cooled via free-convection, unaided by fans. Systems that are fan dependent or fan assisted, or which recommend regularly scheduled maintenance for air filtration components are not acceptable.

K. Panels shall provide a minimum of 52 square inches of cooling surface area for each semiconductor.

L. Panel shall provide capability to electronically assign each circuit to any zone in the dimming system. Panels using mechanical switches, rewiring, or EPROMS shall not be acceptable. All circuits shall be capable of being operated (dimmed or switched where appropriate) from the panel.

1. Where indicated on the drawings, dimming and switching panel(s) shall be capable of operating under two optically isolated control systems. Panel shall be capable of auto detecting between Manufacturer's control protocol and DMX512 protocol for each control system. Panel response to control changes shall take no more than 25 milliseconds. Panel shall be capable of assigning each dimmer to either control system on a circuit by circuit basis. Panel shall also be capable of conditionally changing assignment from one system to the other.

M. Multiple panels shall be capable of operating in one system.

N. For panels fed with a normal/emergency feeder, panel shall include electronics to bring all circuits to an emergency full-on condition upon the loss of normal power and the subsequent presence of emergency power. Designated circuits shall be controlled simultaneously with other lighting circuits within the designated control zone during the presence of normal utility or generator power.

1. Panels listed as emergency shall have all circuits immediately go to a full-on condition. All dimmers shall operate at 100% of input voltage, bypassing any high-end trim. All local control stations are inoperable during this period. Once normal power is restored, all lighting zones shall revert back to their status prior to the emergency condition without requiring any action on the part of the user. Restoration to some other "default" level is not acceptable.

2. This type of emergency full on may be used with either a normal/emergency generator, UPS or IPS system with true sinewave output and maximum of 10% THD. The generator, UPS, or IPS system must be capable of operating under no load conditions or a constant hot secondary utility feed where the emergency transfer occurs on the line side (upstream) of the dimming panel and requires that only a single normal/emergency feeder be brought to the Emergency Dimmer Panel.

3. System shall be capable of meeting local jurisdictions requiring special conditions such as minimum light levels during normal operation or full function, even during emergency power.

2.4 MODULAR DIMMING ASSEMBLIES

A. Dimmer shall be capable of withstanding inrush current of 50 times operating current. In addition, under fully loaded operating conditions, all semiconductor devices shall operate at a minimum 20°C (68°F) safety margin below the component temperature rating.

B. A positive air gap switch shall be employed with each dimmer in the panel to ensure that the load circuits are open when the "off" function is selected from the control system.

C. Each dimmer shall compensate for incoming line voltage variations such as changes in RMS voltage, frequency shifts, harmonics and line noise. Dimmer shall be capable of maintaining constant light level with no visible flicker under the following conditions:

1. ±2% change in RMS voltage/cycle

2. ±2 Hz change in frequency/second

3. Dimmers that do not regulate the dimmer output in real time shall be unacceptable.

D. Each dimmer shall incorporate an electronic "soft-start" default at initial turn-on that smoothly ramps the lights up to the appropriate levels within

0.5 seconds.

E. Once installed as part of a complete system, the semiconductor used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6000V, 3000A (equivalent to a near lightning strike) as specified by ANSI/IEEE Std. C62.41. Upon request, the Manufacturer shall provide a means to demonstrate conformance to this specification using the appropriate surge-generation equipment.

F. One type of dimmer shall be used for all sources, line voltages, and frequencies. Systems requiring different types of modules shall not be acceptable. Dimmer shall be capable of electronic assignment to any source and any zone. Upon replacement of a dimmer, only that dimmer shall require replacement, and no re-programming shall be required.

G. Filtering shall be provided for each dimmer so that current rise time shall be at least 350□sec as measured from 10-90% of the load current waveform and at least 525□sec as measured from 0-100% of the load current waveform at 50% rated dimmer capacity at a 90° conduction angle. Current rise time shall be at least 400□sec as measured from 10-90% of the load current waveform and at least 600□sec as measured from 0-100% of the load current waveform at 100% rated dimmer capacity at a 90ø conduction angle. At no point should current rise faster than 30mA/msec.

H. Dimmer output voltage shall be a minimum 95% of input voltage at maximum intensity setting.

I. Dimmer shall include diagnostic LEDs to verify proper operation and assist in any system troubleshooting.

2.5 MODULAR SWITCHING ASSEMBLIES

A. Assembly shall be capable of withstanding inrush current 75 times operating current. In addition, under fully-loaded operating conditions, all devices shall operate at a minimum 20°C (68°F) safety margin below the component temperature rating.

B. A positive air gap switch shall be employed with each circuit in the power panel to ensure that the load circuits are open when the "off" function is selected from the control system.

C. Relays shall be mechanically latching. Relays shall be of sealed construction type in order to prevent contact degradation.

D. Once installed as a complete system, the relays used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6000V, 3000A (equivalent to near lighting strike) as specified by ANSI/IEEE Std. C62.41. Upon request, the Manufacturer shall provide the means to demonstrate conformance to this specification using the appropriate surge-generation equipment.

E. Relays shall be rated for 16 amps continuous duty, for the following load types: resistive (incandescent/tungsten), inductive (magnetic low voltage, neon/cold cathode, magnetic fluorescent lamp ballasts), and capacitive (electronic low voltage, electronic fluorescent lamp ballasts, high intensity discharge). Relays rated only for resistive loads shall not be acceptable.

F. Load shall be switched in a manner that ensures no arcing will occur at the mechanical contacts when power is applied to the load circuits.

G. Average rated life of relay shall be at least 1,000,000 cycles.

H. Assembly shall include diagnostic LEDs to verify proper operation and assist in any system troubleshooting.

2.6 SOURCES

A. Dimming assemblies shall operate the following sources/load types with a smooth continuous Square Law dimming curve. Dimmers that have visible "steps" of light intensity throughout the control range shall not be acceptable. Dimmers shall also be capable of operating the following sources on a non-dim basis. Dimmers shall be electronically assigned to the appropriate load type/dimming curve and can be reassigned at any time. Universal-type dimmers that do not adjust the dimming curve shall not be acceptable.

2.7 CONTROLS

A. Definitions: A "scene" or "preset" is a specific look or mood created by different lighting zones set at different intensities. A "zone" is one or more lighting circuits which are controlled together as a group.

B. Control shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption without requiring any actions on the part of the user. Restoration to some other default level is not acceptable, unless specifically noted elsewhere.

C. Wiring from dimming and switching panel(s) to centralized preset lighting control and wallstations, preset local lighting controls, and control interfaces shall be low voltage type Class 2 wiring (PELV).

D. Faceplate shall attach using no visible means of attachment.

E. Controls shall be engraved with appropriate zone and/or scene descriptions, furnished to the Manufacturer prior to fabrication. Size and style of engraving type shall be determined by the Architect. Any silk-screened borders, logos, graduations, etc., shall use a graphic process that chemically bonds the graphics to the metal faceplate, resisting removal by scratching, cleaning, etc.

F. Manufacturer shall ensure the following items regarding product color:

1. Product color matches NEMA standard WD1, Section 2, and the maximum color deviation from this standard shall not exceed □E=1, CIE L*a*b color space units. For non-NEMA colors, color match coordination shall be provided on request.

2. Color variation of any control in the same product family shall not exceed □E=1, CIE L*a*b color units.

3. Visible parts shall exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674-89. Manufacturer to submit proof of testing upon request.

G. Controls shall provide an immediate, local LED response upon button activation to indicate that a system command action has been requested. LED will remain lit contingent upon receiving system confirmation of the successful completion of the command.

2.8 SLIDER CONTROL(S)

A. Control shall mount individually in standard 1, 2, 3, 4, 5, 6, or 7 gang U.S. wallboxes.

B. Slider control shall provide 'on' and 'off' for up to twelve (12) control zones. Where indicated, control shall be capable of storing preset lighting scenes. The intensity for each zone shall be indicated by the position of the slider. More than one zone may be proportionately raised or lowered at the same time. Programming of preset scenes shall be accomplished without the use of an 'enter' or 'store' button. Additionally, one or more zones may be temporarily overridden without altering the scene values that are stored in memory. Control shall provide option for Master slider and shall retain "dimming profile".

C. Lighting levels shall fade smoothly between scenes at time intervals of 0 to 59 seconds or 1 to 60 minutes. The fade time shall be separately selectable for each scene and shall be indicated by a digital display for the current scene. Pressing a scene select button will illuminate the corresponding scene LED and simultaneously begin changing the bargraph levels to reflect the currently selected scene. In the event that a preset scene with a fade time greater than 5 seconds is initially selected from an 'off' condition, the programmed fade time shall be temporarily overridden, unless otherwise noted, and the lights shall fade up to that scene over a five-second time span.

2.9 SOURCE QUALITY CONTROL

A. Equipment shall be 100% tested for proper operation at three (3) different levels - printed circuit board, end of line, and for two (2) hours at 40˚C (104˚F) ambient - prior to shipment from the factory. Manufacturers sampling at end-of-line shall not be acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed utilizing manufacturer's catalogue cut sheets and installation instructions and in accordance with these specifications.

B. Contractor shall furnish all equipment, labor, system setup and other services necessary for the proper installation of the products/system as indicated on the drawings and specified herein. System setup shall include defining each dimmer's load type, assigning each load to a zone and setting the control functions.

3.2 MANUFACTURER'S FIELD SERVICES

A. Upon completion of the installation, the system shall be completely commissioned by a factory-employed engineer. The check-out will be performed after all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. The factory-employed engineer shall demonstrate and educate the owner's representative(s) on the system capabilities, operation and maintenance.

B. Manufacturer shall offer upgraded eight (8) year limited warranty based upon successful field commissioning. The warranty shall have a minimum

two (2) year period that covers all parts and labor for repair.

C. Manufacturer shall provide toll-free technical support hotline twenty-four (24) hours per day, seven (7) days per week.

D. Manufacturer shall be capable of providing on-site service support within twenty-four (24) hours anywhere in the continental U.S.A., and within seventy-two (72) hours anywhere in the world, except where special visas are required.

END OF SECTION

SECTION 26 2200 - TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

1.2 SUMMARY

A. Furnish and install general purpose and specialty dry type transformers as specified herein and as indicated on the Drawings.

1.3 SUBMITTALS

A. Provide product data for each type and rating of transformer. Data shall include dimensional plans, sections, and wiring diagrams indicating factory and field wiring.

B. Manufacturer Seismic Qualification Certification: Submit certification that the transformers will withstand seismic forces as defined in ASCE 7. Refer to Division 26 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

    b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic

capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 QUALITY ASSURANCE

A. All transformers and the installation of all transformers shall comply with NFPA 70, National Electrical Code, and Maryland Energy Efficiency Standards Act (EESA), enacted into law on March 1, 2005.

B. Transformers provided under this section shall conform to applicable standards from UL and shall be listed and labeled by UL or a Nationally Recognized Testing Laboratory (NRTL).

PART 2 - PRODUCTS

2.1 DISTRIBUTION TRANSFORMERS

A. Transformers shall be dry type, air cooled, designed for 60 Hz service, having ratings and characteristics as indicated on the Drawings. Ventilated and non-ventilated transformers shall be provided with UL listed enclosures.

B. Transformers rated below 30 KVA shall have 365˚F (185˚C) insulation system and shall be designed for 239˚F (115˚C) rise above a 104˚F (40˚C) ambient.

C. Transformers rated 30 KVA and larger shall have 428˚F (220˚C) insulation system and shall be designed for 302˚F (150˚C) rise above a 104˚F (40˚C) ambient.

D. Cores shall be fabricated from grain oriented, non-aging silicon steel.

E. Coils shall be continuous without splices. Terminations shall be brazed or welded. Shielded transformers shall incorporate an electrostatic shield located between primary and secondary windings.

F. Core and coil assemblies shall be dried, impregnated with varnish or epoxy, and cured to minimize hot spots and reduce noise.

G. Transformers rated 30 KVA and larger shall have two (2) above normal full

capacity 2-1/2 percent taps and four (4) below normal full capacity 2-1/2 percent taps. Taps shall be readily accessible and shall be set in the field.

H. Transformers shall be quiet type, which operate at sound levels below ANSI Standard C89-2. Core and coil assemblies shall be mounted on rubber vibration isolators.

I. Enclosures shall be cleaned and degreased, primed and finished to provide a scratch resistant and weather resistant finish.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with DOE 2016 Efficiency (10 CFR 431).

2. Tested according to NEMA TP 2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Transformers shall be located to provide adequate circulation of cooling air and shall be installed in accordance with the manufacturer's written instructions.

B. Tighten all connectors and terminations in accordance with the manufacturer's published torque-tightening values.

C. Transformers shall be grounded in accordance with NFPA 70, National Electrical Code.

D. Adjust and set taps to provide optimum voltage for utilization equipment taking into account high and low voltage swings, load changes and voltage drop.

E. Provide supports and vibration isolators in accordance with Division-26 section, "Supporting Devices."

END OF SECTION

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this Section.

B. Cabinets and enclosures shall conform to Division-26 Section, Boxes, Fittings and Cabinets.

1.2 SUMMARY

A. Furnish and install panelboards, cabinets and boxes as indicated on the Drawings and as specified herein.

1.3 SUBMITTALS

A. Provide product data for all panelboards, enclosures, cabinets, overcurrent devices and accessories.

B. Provide time-current-characteristic curves for all phase overcurrent devices rated 100 amperes or more and for all ground fault protective devices.

C. Manufacturer Seismic Qualification Certification: Submit certification that the panelboards will withstand seismic forces as defined in ASCE 7. Refer to Division 26 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 QUALITY ASSURANCE

A. Panelboards shall be supplied and installed in strict conformance with NFPA 70, National Electrical Code.

B. Products supplied under this Section shall comply with applicable requirements of UL standards pertaining to panelboards, overcurrent devices, enclosures, and cabinets. Completed assemblies shall be UL listed and labeled.

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Panels shall be of the circuit breaker type, and shall have capacity and arrangement as shown on the panel schedules or one-line diagram.

B. Branch circuit breakers shall be bolt-on type and shall be of the ambient compensated, thermal magnetic type, which will provide inverse time delay overload, and instantaneous short circuit protection. Branch circuit breakers shall have one, two or three poles as designated on the panel schedule. No circuit breakers utilizing handle ties for two or three pole operation shall be acceptable. Voltage and current ratings shall be as indicated on the drawings.

C. Refer to panel schedules on drawings for exact circuit breaker arrangements and interrupting capacities. Provide circuit breakers UL listed as type HACR for air conditioning equipment branch circuits.

D. Main breakers and branch breakers shall have the same minimum

ampere interrupting capacity. Series rating shall not be acceptable.

E. Provide a typewritten directory for each panel, placed inside the panel door. The directory shall list all rooms served by each breaker, using the "Owner's" room numbers. Directories shall be installed in a metal directory frame under glass or minimum 0.03 (.75 mm) inch thick clear non-yellowing plastic. Spares and spaces shall be written in pencil.

F. All circuit breakers which serve time clocks, telephone and communication equipment, refrigerators, exit signs, emergency circuits, fire alarm, security, and other miscellaneous control devices shall be equipped with mechanical handle locking devices.

G. Where panels contain contactors, the contactors shall be mounted behind a hinged, locking door. Contactor section shall be below the circuit breaker section unless otherwise noted. Provide all required barriers. Contactors shall conform to the requirements of Division-26 Section, Disconnects, Switches and Contactors.

H. Each panel shall be equipped with a ground bus, adequate for feeder and branch circuit equipment grounding conductors; bonded to box.

I. Each panel and cabinet and the units comprising same shall bear the manufacturer's nameplate and the UL label. Panelboards used for service entrance equipment shall be UL Service Entrance rated/labeled.

J. All single-phase, three-wire and three-phase, four-wire panels shall be equipped with a fully rated neutral bar. The neutral bar shall be sized to accommodate oversized neutral conductors where oversized neutral conductors are indicated on the Drawings.

K. All bus shall be copper.

L. Cabinet and trim shall be of code gauge steel (minimum) with 4" (100 mm) (minimum) wiring gutter all around. All panelboards shall be equipped with a hinged, locking door and hinged trim. Two (2) keys shall be furnished with each cabinet, and all locks on all cabinets shall be keyed alike. Provide door-in-door panel cover.

M. Where panels occur adjacent to one another in finished spaces, cabinets and doors for each panel shall be of the same height.

N. Panelboards shall be painted with gray over rust preventive primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount panels in locations shown, making sure that code-required clearances exist.

B. Where cabinets cannot be set fully flush due to shallowness of partition, trim protruding sides with approved metal or hardwood molding, fastened to cabinet so as to conceal intersection of wall and cabinet.

C. If paint is damaged during shipping or installation, damaged portion shall be sanded smooth and entire panel repainted.

D. Provide five (5) spare 3/4" (19 mm) conduits stubbed into accessible ceiling spaces above and below each flush mounted panel.

E. Load Balancing: After substantial completion, but not more than 60 days after final acceptance, measure load balancing and make circuit changes.

1. Measure loads during periods of normal system loading (coordinate with Owner).

2. Perform load balancing circuit changes outside normal occupancy/working schedule of the Owner at time directed by Owner's representative.

3. After circuit changes are completed, recheck loads during normal load period. Record all load readings before and after changes and submit test results.

4. Tolerance: Difference exceeding 20 percent between phases within a panelboard is not acceptable. Rebalance and recheck as necessary to meet this requirement.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

B. The requirements for outlet boxes and device enclosures are provided in Division-26 Section, "Boxes, Fittings and Cabinets".

1.2 SUMMARY

A. The Contractor shall furnish and install all wiring devices indicated on the Drawings or specified herein.

1.3 SUBMITTALS

A. Provide product data for each type of wiring device specified.

1.4 QUALITY ASSURANCE

A. All products and the installation of all products shall comply with NFPA 70, "National Electrical Code."

B. Wiring devices shall be listed and labeled by UL and shall confirm to the latest UL and NEMA standards pertaining to wiring devices.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. All wiring devices shall be Specification Grade.

B. Wiring devices shall be white) in color unless otherwise indicated.

C. Convenience receptacles shall be duplex, grounding type, 20A, 2P, 3W, 125V, NEMA 5-20R, straight blade, nylon or high-strength thermoplastic material.

D. Safety receptacles (tamper-resistant) shall be flush, specification grade, grounding type, 20A, 2P, 3W, 125VAC, NEMA 5-20R, straight blade, nylon or high-strength thermoplastic material unless indicated as special purpose outlet. Receptacles shall be designed to accept standard two-wire parallel connector caps and shall grip both sides of the connector wire. Receptacles shall utilize dual shutter system to prevent insertion of foreign objects.

E. Convenience receptacles serving bathrooms, toilets, garages, outdoor and wet locations, and construction sites shall be of the ground fault interrupter type, duplex, grounding type, 20A, 2P, 3W, 125V, NEMA 5-20R, straight blade, nylon or high-strength thermoplastic material.

F. Convenience receptacles located in wet locations shall be of the ground fault interrupter, weather resistant type, duplex, grounding type, 20A, 2P, 3W, 125V, NEMA 5-20R, straight blade, nylon or high-strength thermoplastic, corrosion resistant material.

G. Transient voltage surge suppressor (TVSS) receptacles shall provide equal surge protection of not less than 80 joules for phase-to-neutral, phase-to-ground and neutral-to-ground protection. The TVSS receptacle shall provide an average of 7:1 EMI and RFI noise reduction from 500 kHz to 30 mHz. TVSS receptacles shall be duplex, grounding type 20A, 2P, 3 W, 125V, NEMA 5-20R, straight blade, nylon material.

H. Automatically controlled receptacles shall be labeled as required by NEC article 406.3 (E).

I. Single throw toggle switches shall be quiet type rated 20A, 1P, 120/277 VAC.

J. Single throw lighted toggle switches shall be quiet type rated 20A, 1P, 120/277 VAC, illuminated red polycarbonate handle. Handle shall glow when switch is on.

K. Key operated light switches shall be rated 20A, 1P, 120/277 VAC, gray toggle cover, with two (2) keys furnished for each switch. All switches shall operate from the same key.

L. Three-way toggle switches shall be quiet type rated 20A, 120/277 VAC. Switches shall be positive-action type and shall not permit a maintained neutral position.

M. Four-way toggle switches shall be quiet type 20A, 120/277 VAC. Switches shall be positive-action type and shall not permit a maintained neutral position.

N. Photo control relays shall be as specified in Division-26 Section, Lighting Fixtures.

O. Wall plates for switches, receptacles, etc. in indoor dry areas, shall be satin finish stainless steel Type 302 for concealed raceways; and zinc-coated sheet steel or cast metal having round or beveled edges, for exposed raceways. Install galvanized steel wallplates in unfinished spaces.

P. Wallbox Dimmers and Switches:

1. All devices shall be UL listed specifically for the required loads (i.e., incandescent, fluorescent, low voltage, electronic low voltage). Manufacturer shall provide file card upon request. Universal dimmers shall not be acceptable.

2. All dimmers and switches shall incorporate an air gap, which shall be accessible without removing the faceplate. The air gap switch shall be capable of meeting all applicable requirements of UL 20 and UL 1472 for air gap switches in incandescent dimmers. All dimmers and switches shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.

3. Dimmers and switches shall meet ANSI/IEEE Standard C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage.

4. Dimmers and switches shall meet the UL 20 and UL 1472 limited short circuit test requirement for snap switches.

5. Dimmer control shall be linear slide. Dimmer shall provide a smooth and continuous Square Law dimming curve.

6. Dimmer shall be voltage regulated so that a +10% variation in line voltage shall cause not more than a +5% variation in load voltage when dimmer is operating at 40V (5% light output).

7. Dimmers shall utilize a LC filter network to minimize interference with properly installed radio, audio and video equipment.

8. Dimmer control slider shall be captured.

9. Faceplate shall snap onto device with no visible means of attachment. Heat fins shall not be visible on front of device. At locations with multiple devices, one (1) seamless, multi-gang

faceplate shall be provided. Contractor is responsible for coordination of proper backbox size and faceplate type.

10. Dimmers, switches and faceplates shall be Lutron Nova T style, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting and installation of electrical boxes and wiring.

C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wallplates after painting work is completed.

F. Install telephone/power service poles in accordance with final furnishing arrangement plan, plumb, true, and secure.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

H. Protect installed components from damage. Replace damaged items prior to final acceptance.

I. Provide weatherproof, in-use covers for all receptacles located in wet locations per NEC 406.9(B).

3.2 TESTING

A. Prior to energizing circuits, test wiring for electrical continuity and short-circuits. Ensure proper polarity of connections is maintained. Subsequent

to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six (6) times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

END OF SECTION

SECTION 26 2736 - ELECTRICAL CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

1.2 SUMMARY

A. The Contractor shall provide electrical connections to and between all equipment indicated on the Drawings and Schedules and in the Specifications.

B. Electrical connections shall be provided for, but not limited to, electrical heaters; lighting fixtures; motors; motor starters and controllers; electrical distribution equipment; converters, rectifiers, transformers, and inverters; and communication, computer, clock, intercom, telephone, security, fire alarm and video systems.

C. Unless otherwise specified, the Contractor shall, under this Section, mount and align all starters, control devices, safety switches and other related equipment whether specified in this or other Sections of the specifications, except where such items are factory mounted on the driven equipment. The mounting and alignment of starters and control devices for the automatic temperature control system are included in the Sections in which the equipment is specified.

D. Unless otherwise specified, the Contractor shall, under this Section of the specifications, provide all wiring, including conduit, wire, junction boxes, disconnecting switches, overcurrent protection, etc., not specified elsewhere in this specification, to and between all motors, starters, control devices and related electrical equipment, whether specified in this or other Sections of this specification, except where such items are factory wired, as well as factory mounted on the driven equipment.

E. Wiring for the automatic temperature control system is specified in other Sections of the specification.

F. Unless otherwise specified, all wiring to motors, control equipment and related electrical equipment, shall be installed in conduits with flexible metal conduit connections utilized for final motor connections. Flexible

conduits shall be large enough to accommodate motor feeder, ground conductors and control wires, whether or not so indicated on the drawings. Flexible conduits shall be limited to a maximum length of 6'-0" (1800 mm-0 mm).

G. The drawings are diagrammatic. It is imperative that the contractor obtain exact rough-in information for all equipment well in advance of actual installation to provide coordination for his and other trades.

1.3 SUBMITTALS

A. Submit product data for all materials and components used for electrical connections.

1.4 QUALITY ASSURANCE

A. All materials and components and the installation of all materials and components shall comply with the requirements of the following standards:

1. NFPA 70 "National Electrical Code"

2. IEEE Standard 241 "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings"

3. Applicable standards of ANSI/IEEE and NEMA pertaining to the products and installation of products for electrical connections

4. UL Standard 486A "Wire Connectors and Soldering Lugs for Use with Copper Conductors"

B. All materials and components shall be listed and labeled by UL or ETL.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all materials and components required for complete splices and terminations of all circuits. All wiring shall be spliced and terminated using lugs and/or terminal blocks, except as permitted elsewhere in these Specifications.

B. All splices in branch circuit wiring rated 600 volts and less, except as permitted elsewhere in these Specifications, shall be made using

compression type lugs specifically designed for the type, size and rating of the conductor. The lugs shall be installed using a tool specifically designed for the purpose.

C. Splices in copper branch circuit wiring for sizes #12 and #10 AWG may be made with non-tool, pre-insulated, molded wire connectors with integral self-locking spring grip.

D. All terminations of feeders and branch circuit wiring rated 600 volts or less, except as noted elsewhere in these specifications, shall be made using mechanical clamp-type set-screw lugs. Lugs which incorporate direct contact between the set-screw and the conductor shall not be permitted.

E. Tapes:

1. Self-adhesive tapes shall be used to insulate conductor splices. Terminations shall be in conformance with the following standards:

   a. 600 Volts, Nominal and Less: UL 510, ASTM D-2754, ASTM D-3005, and ASTM D-4388.

   b. 600 Volts through 69 Kilo Volts: ASTM D-4388 and IEEE 48.

2. Vinyl plastic electrical tape shall be used for all terminations and splices of conductors for circuits of 600 volts nominal and less, except terminations in motor terminal boxes, transformer terminations, lighting and all heat producing equipment terminations. Terminations of the equipment listed herein shall be insulated with pressure sensitive glass cloth tape.

3. Ethylene propylene rubber (EPR) high voltage insulating tapes with liner shall be used for all splices and terminations over 600 volts nominal. The tapes shall be included a standard component of the manufacturer's compiled high voltage splice termination kits. All splices and terminations of 5 kV and 15 kV cables shall be accomplished with high voltage splice and termination kits only.

4. Tapes and high voltage splice and termination kits shall be the standard product of 3M Corporation, Plymouth Rubber Company, Inc. or approved equivalent.

F. Special lugs may be required to accommodate the size and number of conductors shown on the Drawings. The Contractor shall verify lug requirements for all circuit breakers and equipment terminals and shall provide correct lugs as required.

G. Pre-insulated solderless ring or spade type crimp connectors and terminals shall be used for all alarm and control circuits.

H. All connectors and terminals shall be of the proper size and ampacity, material and type for the application and service.

2.2 RACEWAYS AND FITTINGS

A. The Contractor shall provide raceways and fittings of the types, sizes, and finish indicated for each type of service. Where the type of raceway is not specified, the Contractor shall provide and install a raceway of proper selection as determined by the installer to fulfill the wiring and equipment connection requirements and comply with NEC requirements for raceways.

B. All raceways and fittings and the installation of all raceways and fittings shall comply with the requirements of these Specifications.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Contractor shall inspect the area where electrical connections are to be installed. The installation of electrical connections shall not be permitted until site conditions are satisfactory.

3.2 INSTALLATION

A. The Contractor shall install all electrical connections in accordance with the manufacturer's written instructions using recognized industry practices.

B. Power, control, data, signal and communication circuits shall be connected to equipment in accordance with the manufacturer's wiring diagrams. The Contractor shall be fully responsible for the correct termination and interface of all electrical connections.

C. Splices shall be insulated with tape which provides an insulation rating which meets or exceeds the insulation rating of the conductor. All outdoor splices shall be made watertight using tapes and sealants specifically designed and listed for outdoor applications.

D. Wiring devices shall not be used as splices.

E. Electrical connections shall be tightened in accordance with equipment manufacturer's published torque tightening values. The installer shall use proper tools which shall include torque screwdriver, torque wrench, and ratchet wrench with adjustable torque settings.

F. UL Standard 486A torque tightening values shall be used when manufacturer's published tightening values are not available.

3.3 TESTING

A. All electrical connections shall be tested to ensure electrical continuity and compliance with these Specifications.

B. The Contractor shall demonstrate to the Owner or Engineer that a random selection of electrical connections has been tightened in accordance with the manufacturer's published torque tightening values.

END OF SECTION

SECTION 26 2816 - DISCONNECTS, SWITCHES AND CONTACTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

1.2 SUMMARY

A. The Contractor shall furnish and install circuit and motor disconnect switches, remote control switches and magnetic contactors where indicated on the Drawings and where required by the National Electrical Code, local codes and the authority having jurisdiction.

1.3 SUBMITTALS

A. Provide product data for each type and rating of circuit and motor disconnect switch.

1.4 QUALITY ASSURANCE

A. Circuit disconnects and motor disconnect switches and the installation of same shall comply with the requirements of NFPA 70, "National Electrical Code."

B. Circuit and motor disconnect switches shall be listed and labeled by UL.

PART 2 - PRODUCTS

2.1 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Switches shall be constructed in accordance with the latest editions and revisions of NEMA Standard KS-1, Federal Specification W-S-685C, and Underwriters' Laboratories Standard 98.

B. Switches shall be fusible or non-fusible as indicated on the Drawings, or as required by the equipment served, horse-power rated, quick-make, quick-break, heavy-duty type with integral arc suppressors. The handle

shall be part of the enclosure, not the cover.

C. Fused switches and fuses shall have a minimum integrated interrupting rating of 100,000 amperes RMS symmetrical.

D. Switches 800 amperes and larger shall be bolted pressure type.

E. Switches used for service entrance shall be service rated and bear the U.L. service entrance label.

F. Switches shall have general purpose surface mounted NEMA type 1 or 3R enclosures as indicated or required by locations. All enclosures shall be designed to permit padlocking in the "open/off" position.

G. Switches on 120/208 volt service shall be rated 240 volts and switches on 277/480 volt service shall be rated 600 volts.

H. Fused switches for motor applications shall be furnished with UL listed dual-element Class RK-1 time delay fuses rated 600 volts. Fuse current ratings shall be as indicated on the Drawings or in accordance with the motor manufacturer's recommendations when specific sizes are not specified on the Drawings.

2.2 REMOTE CONTROL SWITCHES

A. Remote control switches shall be electrically operated, mechanically held. The main contacts shall be power driven to both the open and closed positions. Operating mechanisms which rely on gravity or permanent magnets shall not be used.

B. The contacts and operating mechanism shall be enclosed by an insulated cover. A safe manual operator shall be provided to either open or close the switch.

C. The main contacts shall be silver alloy composition and shall be protected by arcing contacts on sizes 600 amperes and above. Auxiliary contacts shall be rated 10A, 120 VAC. Provide one normally open and one normally closed auxiliary contact.

D. Contacts, power and control connections, coils, and arc chutes shall be accessible and serviceable from the front.

E. The remote control switches shall be rated in amperes for a total system load including motors, lighting ballasts, and resistive and tungsten filament lamp loads.

F. Remote control switches shall be individually enclosed or panelboard mounted as indicated on the drawings. Enclosures shall comply with the requirements of Division-26 Section, "Boxes, Fittings and Cabinets."

G. Remote control switches shall have a UL listed withstand current rating equal to or exceeding the available short-circuit current at the location where the switch is to be installed.

H. The remote control switch shall be arranged for two-wire control from a maintained type control switch. All controls and modules, with the exception of the control switch, shall be located in the same enclosure with the remote control switch.

2.3 MAGNETIC CONTACTORS

A. Magnetic contactors shall be electrically operated, mechanically held.

B. The contacts and operating mechanism shall be enclosed by an insulated cover.

C. The main contacts shall be silver alloy composition and shall be protected by arcing contacts on sizes 600 amperes and above. Auxiliary contacts shall be rated 10A, 120 VAC. Provide one normally open and one normally closed auxiliary contact.

D. Contacts, power and control connections, coils, and arc chutes shall be accessible and serviceable from the front.

E. Contactors shall be rated in amperes for a total system load including motors, lighting ballasts, and resistive and tungsten filament lamp loads.

F. Contactors shall be individually enclosed or panelboard mounted as indicated on the Drawings. Enclosures shall comply with the requirements of Division-26 Section, "Boxes, Fittings and Cabinets."

G. Contactors shall have a UL listed withstand current rating equal to or exceeding the available short-circuit current at the location where the switch is to be installed.

H. The contactor shall be arranged for two-wire control. All controls and modules, with the exception of control switches, push buttons and pilot lights shall be located in the same enclosure with the contactor.

2.4 CONTROLS

A. Push buttons shall be momentary contact, heavy duty, oiltight with

legend plate. Buttons shall be fully guarded and shall be red in color.

B. Selector switches shall be two position, heavy duty, oiltight with legend plate.

C. Contact blocks shall be provided as required for all push buttons and switches. Contacts shall have a 10 ampere continuous current rating at 120 VAC or 120 VDC except where indicated otherwise.

D. Pilot lights shall be heavy duty, oiltight with legend plate. Pilot lights shall utilize incandescent lamps designed for high brightness applications. Lens shall be acrylic fresnel type of the color specified.

E. Control stations shall be recessed with sufficient space to accommodate operators as required. Provide stainless steel NEMA 1 flush cover plates.

F. Boiler emergency stop switches shall be guarded, red toggle-type, single pole, rated 30 amperes at 250 VAC. Switch shall be enclosed in a single gang outlet box with red coverplate and legend to read "EMERGENCY STOP". A nameplate shall be provided to indicate the equipment served. The electrical contractor shall route 3/4" conduit and control wires from each switch to boiler control panel. Coordinate wiring type and quantity with boiler manufacturer. Leave six (6) feet of slack within boiler control panel for final termination by ATC contractor. Coordinate connection point in boiler control panel with boiler manufacturer.

2.5 ACCESSORIES

A. Provide electrical interlocks where indicated on the Drawings.

B. Provide one normally open and one normally closed auxiliary contact on each switch. Auxiliary contacts shall be rated 10A, 120 VAC.

C. Fused disconnects and switches shall be provided with integral built-in fuse pullers arranged to facilitate fuse removal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Switches shall be coordinated with the equipment to provide switches to suit the particular equipment characteristics and requirements.

B. Provide fusible switches for all equipment labeled for and/or requiring fuse protection.

C. Switches shall be installed in accordance with manufacturer's published instructions.

D. Provide three (3) spare fuses of each type and rating furnished for this project. Deliver spare fuses to the Owner's place of storage.

3.2 TESTING

A. Prior to energizing circuits and switches, test wiring for electrical continuity and short-circuits.

END OF SECTION

SECTION 26 2817 - ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes molded-case circuit breakers in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches

1.3 SUBMITTALS

A. Division-01 Section - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

PART 2 - PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1 with interrupting capacity to comply with available fault currents.

B. Accessories: Conform to NEMA AB 1.

1. Shunt Trip Device
2. Auxiliary Switch
3. Electrical Operator
4. Handle Lock: Provisions for padlocking (NEMA 12 enclosure)
5. Grounding Lug: In each enclosure

C. Enclosed circuit breakers shall have general purpose, surface mounted, NEMA Type 1 or 3R enclosure as indicated or required by location.

D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 250 A and larger.

E. Service Entrance: Enclosed circuit breakers identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

F. Circuit breakers shall be fully rated. Series rated withstand are prohibited.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed circuit breakers plumb. Provide supports in accordance with Division-26 Section, "Supporting Devices."

B. Height: 5 feet (1500 mm) to operating handle.

C. Locate and install engraved plastic nameplates in accordance with Division-26 Section, "Basic Electrical Materials and Methods."

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with National Electrical Testing Association (NETA).

END OF SECTION

SECTION 26 2913 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this Section.

1.2 SUMMARY

A. Furnish and install motor controllers where indicated on the Drawings, where required by the Contract Specifications, and where required for the control and protection of motors as necessary for a complete installation.

B. The variable frequency drive (VFD) manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFDs that are manufactured by a third party and "brand labeled" shall not be acceptable. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a "brand labeled" drive. All VFDs installed on this project shall be from the same manufacturer.

1.3 SUBMITTALS

A. Submit shop drawings and product data for all motor controllers and motor control centers.

B. Submittals shall include equipment dimensions, power and control wiring diagrams, component descriptions, calculations where required and ratings, and a list of recommended spare parts.

C. Complete operating and maintenance manuals shall be provided which include technical data sheets, wiring diagrams and information for ordering replacement parts.

D. The manufacturer shall submit a copy of the specifications with each sub-paragraph noted with the term, "compliance", "deviation", or "alternate".

1. By noting the term "compliance" it shall be understood that the

manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.

2. By noting the term "deviation" it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.

3. By noting the term "alternate" it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. Any alternate shall be fully described as to what the manufacturer proposes to provide.

E. Harmonic Conditioning and Line Filtering: Submit a detailed description and product data for the harmonic filtration mitigation devices provided for each VFD installed for this project. Harmonic filtering shall be provided as indicated on the drawings and in this specification.

F. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519-2014, Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

1. List all drives.

2. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion (THD) and total demand current distortion (TDD) is no more than that allowed by IEEE 519-2014 at the point of common coupling (PCC). Filters shall be sized based on harmonic calculation results and provided as indicated elsewhere in this specification.

3. The Point of Common Coupling (PCC) and associated available short circuit current (I_{SC}) and peak load (I_L) is indicated on the drawings. All harmonic calculations shall be based on this PCC. The analysis report shall include a technical description of all inputs and outputs from the software/programs used.

4. Submit a detailed description and product data for the harmonic filtration mitigation devices provided for each VFD installed for this project.

G. Variable Frequency Drive (VFD) submittals shall be submitted under separate, stand-alone submittal package when VFD is provided by Division-23 as part of mechanical equipment.

1.4 QUALITY ASSURANCE

A. Motor controller components and assemblies shall be furnished and installed in accordance with NFPA 70, National Electrical Code, and shall conform to the requirements of UL 845 and applicable sections of NEMA and ANSI/IEEE standards.

B. Motor controllers shall be listed and labeled by Underwriters' Laboratories or a Nationally Recognized Testing Laboratory (NRTL).

C. Source Limitations: Obtain Motor Controllers through one source from a single manufacturer.

D. VFDs and options shall be UL508 listed as a complete assembly. The base VFD shall be UL listed for 100 kA SCCR without the need for external input fuses.

PART 2 - PRODUCTS

2.1 FRACTIONAL HORSEPOWER STARTERS

A. Fractional horsepower manual starters shall be used for single phase motors except where indicated. Single phase starters shall provide across the line starting and overload protection. Single pole and double pole starters shall be used as required and shall be rated not less than 1 horsepower.

B. Single phase manual starters shall feature snap action double-break contacts, motor running indicating light and trip free melting alloy overload elements selected for the specific motor application.

C. Single phase manual starters located in mechanical and electrical rooms shall be installed in NEMA 1 general purpose enclosures. Starters located outdoors or in wet locations shall be installed in NEMA 4 watertight enclosures. Starters located in finished areas shall be installed in a flush outlet box and furnished with a stainless steel plate.

D. Manual motor starters shall be toggle-type and shall be arranged so they may be locked with a padlock in the OFF position.

2.2 COMBINATION STARTERS

A. Combination motor starters shall be provided with an integral motor circuit protector specifically designed for motor applications. The MCP shall have a continuous current rating in accordance with NEC Article 430

and shall provide adjustable short-circuit trip settings. The MCP shall have a minimum short-circuit rating of 42,000 amperes at 480 volts.

B. An external operating handle for the MCP shall be provided. The handle shall clearly indicate the position of the MCP and shall be padlockable in the OFF or OPEN position. Interlocks shall be provided to prevent opening the door when the external operating handle is in the ON or CLOSED position. An interlock defeater shall be provided for use by authorized personnel.

C. Magnetic-type motor starters shall be used for single phase motors where indicated and for all three phase motors.

D. Starters shall be full voltage non-reversing (FVNR) or reduced voltage type as indicated on the Drawings. Starters shall utilize three temperature compensated bimetallic overload relays factory set for the specific motor application. Overload relays shall be field adjustable plus or minus 15 percent of the rated trip current. Solid state overload relays are acceptable.

E. Starters shall be furnished with the following accessories:

1. Hand-off-auto selector switch.

2. Green pilot light to indicate power available to the starter but motor not on.

3. Red pilot light to indicate motor running.

4. Transformer for 120 volt control power (fused primary and secondary).

5. Overload trip indicator and reset.

6. Undervoltage monitor and release.

7. Coils rated 120 volts A.C.

8. Two (2) normally open and two (2) normally closed auxiliary contacts for customer use.

F. Reduced Voltage Starter:

1. Solid state starters shall be provided with Class 20 electronic overload and phase loss, current unbalance, undervoltage and overtemperature protection.

G. Starters shall be capable of withstanding the let-through short-circuit

current of the protective device. Current limiters shall be provided when required to achieve adequate protection from high short-circuit currents.

H. Where the Drawings indicate individual enclosures for starters, the starters shall be provided in NEMA type 1 enclosures except when noted otherwise on the Drawings. Outdoor starters shall be in NEMA 3R enclosures.

I. Starters to be installed in motor control centers shall conform to these specifications and the section pertaining to motor control centers.

2.3 VARIABLE FREQUENCY DRIVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary; Basis of Design: ACH580 with E-Clipse Bypass when bypass is required.

2. Yaskawa Electric America, Inc.

3. Danfoss, Inc.; Danfoss Electronic Drives Division

4. Toshiba International Corporation

B. Variable Frequency Drives (VFD) shall be of a Pulse Width Modulated (PWM) design with an input power factor greater than 0.95 at all operating speeds and loads. The VFD shall have an efficiency of 96% or greater at rated output.

C. The VFD shall be microprocessor based and utilize digital input for parameter adjustments. Use of potentiometers for parameter adjustment is not acceptable.

D. The VFD shall automatically attempt to restart after a malfunction or an interruption of power. The number of attempted restarts shall be customer selectable (0 to 5). If the drive reaches the limit of restarts without successfully restarting and running, restart circuit shall lockout.

E. A current limit circuit shall be provided to limit motor current to a preset adjustable maximum level by reducing the drive operating speed or acceleration rate when the limit is reached. Range of adjustment shall be from 50 to 110% of controller rated output.

F. The VFD shall include a digital display and digital input programming capability. The display shall be programmable for indication of output

speed in rpm, frequency or percent of base speed; motor current (amperes) and output motor voltage. The display shall also function as a first fault indicator.

G. Upon receipt of N.O. "dry" contact closure, the VFD shall run at a preset (field adjustable) speed.

H. The VFD shall provide selection for Hand-Off-Auto control. In Hand mode, the motor shall be started and stopped from the operator's panel. In the Auto mode, the motor shall be started and stopped by remote contact closure. In the Off mode, the motor shall be locked out. The Hand-Off-Auto control shall operate in both the VFD mode and the bypass mode (if bypass is provided).

I. The VFD shall provide selection for Manual ref/Auto ref. In the Man ref. mode, the VFD speed reference shall be set from the operators panel. In the Auto ref. mode, the VFD speed reference shall be set by the external source instrument signal.

J. The input signal follower circuit shall have selectable differential inputs and accept an electrical speed command from an external source rated at 4-20 mA or voltage signals of 0-10 Vdc.

K. Electronic motor protection shall be provided. The protection circuit shall provide orderly shutdown.

L. The VFD shall include a programmable 4-20 ma analog output which shall be capable of indicating output frequency, motor speed, output current, motor torque, motor power or motor voltage. The VFD shall include a minimum of two programmable digital outputs (form C relay contacts) capable of indicating drive run, drive fault, and drive ready. The VFD shall include an interface chip to provide open protocol capability for interface with the Energy Management/ATC system. Coordinate protocol with Energy Management/ATC manufacturer.

M. The VFD stopping mode functions shall be selectable for coast to rest or stopping at programmed deceleration rate.

N. In the event of loss of input follower reference signal (transducer failure), the VFD shall go to a preset speed which shall be user adjustable. The VFD shall provide a digital output signal (form C relay contact) to indicate the loss of reference condition.

O. The input current rating of the VFD shall not be greater than the output current rating. VFDs with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.122. Input and output current ratings must be shown on the VFD

nameplate.

P. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.

Q. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.

R. The VFD shall include password protection against parameter changes.

S. The VFD shall operate within the following ratings and provide the following characteristics:

1. Output frequency range: 1-120 Hz.

2. Frequency resolution: 0.5% of base speed with analog input 0.025% with digital input.

3. Overload rating: 110% for one minute.

4. Voltage Tolerance:

   a. The VFD shall provide full rated output from an input voltage of 480 V +/-10% or 208V +/- 10%. Coordinate with motors specified.

   b. The VFD shall continue to operate without faulting from an input voltage of +30% to -35% of nominal voltage.

5. Minimum speed: 0 to 70%.

6. Maximum speed: 30 to 120%.

7. Linear accel: 1 to 300 seconds, time adjustable.

8. Linear decel: 1 to 300 seconds, time adjustable.

9. Maximum output voltage: adjustable.

10. Adjustable V/Hz with selectable profiles.

11. Operating temperature: 32 degrees F to 104 degrees F (0 degrees C to 40 degrees C).

12. Altitude: 3300 feet (1000 m).

13. Humidity: 95% non-condensing.

14. Minimum three frequency avoidance bands, field selectable.

T. Bypass: Where indicated on the contract documents, provide single enclosure containing a variable frequency drive and bypass system. All VFD with bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

1. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker (defeatable), output contactor, bypass contactor, service (isolation) switch and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes. Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both the VFD and the Bypass will not be accepted. The door interlocked, padlockable circuit breaker must disconnect all input power from the drive and all internally mounted options.

2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed. The interlock must be defeatable for maintenance activities.

3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 Amps and this rating shall be indicated on the UL data label.

4. Drive Isolation Fuses - Fast acting fuses shall be provided to disconnect the VFD from the line prior to clearing upstream branch circuit protection to maintain bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor "isolation contactors" are not an acceptable alternative to fuses, as contactors could weld closed and are not an NEC recognized disconnecting device.

5. Bypass Mode: Field-selectable Automatic or Manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.

6. Class 10, 20, or 30 (programmable) electronic motor overload protection shall be included.

7. Bypass Controller: Two-contactor-style (bypass and output) bypass allows motor operation via the VFD or the bypass controller; with input isolating switch arranged to isolate the power to the VFD and permit safe troubleshooting and testing, both energized and de-energized, while the motor is operating in bypass mode.

    a. Bypass Contactor: Load-break, IEC-rated contactor.

    b. Output Isolating Contactor: Non-load-break, IEC-rated contactor.

    c. Isolating Switch: Non-load-break switch arranged to isolate the VFD and permit safe troubleshooting and testing of the VFD, both energized and de-energized, while the motor is operating in bypass mode.

8. Bypass Configuration:

    a. Less than 75 horsepower: Full-voltage (across-the-line) non-reversing.

    b. 75 horsepower and above: Reduced voltage soft start.

U. Redundant Drive Enclosure: Where indicated on the contract documents, provide single drive enclosure containing two variable frequency drives of the horsepower indicated on mechanical schedules.

1. Enclosure cover shall be provided with:

    a. Common main disconnecting means.

    b. External lead drive selector switch (VFD 1 / VFD 2).

    c. Auto/off/manual selector switch.

    d. Drive run and fault lights for each individual drive.

    e. External fault light.

    f. Individual drive control panels (keypads) shall be accessible without opening enclosure door.

2. Drives within the enclosure shall be individually fused for uninterrupted operation. Drive shall automatically switch from lead drive to redundant drive upon a lead drive fault.

3. The output of each inverter shall be isolated using electronically interlocked contactors.

4. A common power distribution block shall tie the outputs together with individual manual motor protectors.

5. Isolating Switch: Each drive shall be equipped with a non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while the other drive is operating.

6. Drive shall be provided with a customer terminal block to allow single point connection for external building automation system and fire alarm system safety interlocks.

    a. Provide ModBus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet MS/TP in the resident memory.

V. The VFD power circuit shall be fused and isolated internally with respect to ground. Phase loss protection shall be provided to prevent single phasing.

W. The VFD shall be capable of continued operation during an intermittent loss of power for 0.1 seconds (6 cycles). Opening of the VFD's input and/or output line switches while operating shall not result in damage to the power circuit components.

X. The VFD shall have an instantaneous electronic trip circuit breaker to protect the VFD from output line-to-line and line-to-ground short circuits.

Y. Surge Suppression: Factory installed as an integral part of the VFD, complying with UL 1449 SPD, Type 1 or Type 2. The VFD shall include a coordinated AC transient surge protection system consisting of 4 MOVs (phase to phase and phase to ground), a capacitor clamp, 1600 PIV Diode Bridge and internal chokes. The MOV's shall have a minimum 125 joule rating per phase across the diode bridge. VFDs that do not include coordinated AC transient surge protection shall include a Surge Protection device Joslyn JSP, SSI or approved equal as an integral component to the VFD package.

Z. The VFD shall be able to start into a rotating motor (any speed or direction) and accelerate (decelerate) to set speed without tripping or component loss.

AA. The maximum cable length between the VFD and the motor is 100 feet (30 m). Provide integral Dv/Dt output filters on load side of drive for motor

protection where length is greater than 100 feet. Line reactors are not an acceptable substitute for the Dv/Dt output filter.

BB. Enclosures:

1. VFD Enclosures: Enclosures shall be UL508, listed as a complete assembly from the factory or shall be evaluated in the field by a Nationally Recognized Testing Laboratory (NRTL) under a field evaluation program. Enclosures shall be suitable for floor or wall mounting as indicated. Enclosure type shall be provided according to environmental conditions at installed location as indicated below:

    a. Dry and Clean Indoor Locations: UL Type (NEMA) 1.

    b. Outdoor Locations: UL Type (NEMA) 3R.

    c. Outdoor Corrosive Locations: UL Type (NEMA) 3R Stainless Steel Construction.

    d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL Type (NEMA) 12.

    e. Filtered or Non-filtered design as indicated on design drawings.

2. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFD as "Plenum Rated."

3. See drawings for enclosure type.

2.4 HARMONIC CONDITIONING AND LINE FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519-2014 recommendations.

1. At a minimum, provide an input filter with 5% impedance. 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% swinging AC line reactors. VFDs with only one DC reactor shall add an AC line reactor, no exceptions.

2. Acceptable additional harmonic filtration mitigation devices:

    a. Integral AC Line Reactors

b. Integral passive harmonic filters

c. Active front end

d. 12 pulse or 18 pulse PWM design

B. Output Filtering: Provide dV/dT output filters on load side of drive for motor protection where length exceeds motor manufacturer recommendations or 100 feet, whichever is smaller.

C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for First Environment restricted level (Category C2) with up to 100 feet of motor cable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor starters, controllers and motor control centers as indicated on the Drawings, in strict accordance with the manufacturer's written instructions, and in compliance with recognized industry practices.

B. Install fuses or current limiters when required by the equipment specifications.

C. Tighten connections and terminations in accordance with the manufacturer's published torque tightening values or in accordance with UL Standard 486A and B when manufacturer's values are not indicated.

D. Prior to energizing equipment, check power and control wiring for correct installation. After energizing equipment, check each motor for proper phase rotation, correct where necessary, and demonstrate operation of starter and accessories.

E. Program VFDs as required for each individual load. Programming shall include preset speeds, restart attempts and delays, overload settings, frequency avoidance bands, etc.

F. The installation of external filters with VFDs shall include all necessary conduit and wiring between the filter and the VFD. Where VFD bypass switches are provided, filter shall be connected so that it is isolated from the VFD in the bypass mode.

G. Set all MCPs in accordance with manufacturer's instructions. Set all overloads in accordance with motor manufacturer instructions.

3.2 SPARE PARTS

A. Provide ten (10) lamps of each type and rating supplied with the specified equipment.

B. Provide one (1) of each type of fuse and current limiter for each ten (10) installed, but not less than three (3) of each type and rating.

C. VFD Keypad: Provide one keypad for each type of VFD provided.

END OF SECTION

SECTION 26 3213 - DIESEL GENERATOR SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this Section.

1.2 SUMMARY

A. The Contractor shall furnish and install a factory assembled diesel-engine-driven generator set including fan, radiator, rigid mounting base, vibration isolators, silencer, overcurrent protection, day tank, sub-base fuel tank, controls and all accessories specified herein and as required for a complete and functional system.

B. The diesel-engine-driven generator system shall comply with the requirements of NFPA 110, Type 10, Level 1, Class 6 emergency power supply systems.

1.3 SUBMITTALS

A. Submit manufacturer's data sheets, wiring schematics installation dimensional drawings for Owner/Engineer, review, comments, and/or approval.

B. Identify all specified items on submittals to assure compliance and ease of review and/or approval.

C. Prior to final test and acceptance, submit final data sheets, schematics and dimensional drawings in neat brochure form.

D. Submittal Data Required:

1. Complete installation drawings, including plan view and elevation with connection of required utilities clearly indicated.

2. Engine/generator controls.

3. Actual electrical schematic, interconnection, and control diagrams.

4. Exhaust silencer and vibration isolators.

5. Battery, battery rack, and battery charger data and installation details.

6. Engineering performance data sheets describing engine, engine performance, fuel consumption rates at 1/4, 1/2, 3/4 and full load, ventilation and combustion air CFM generator details and performance data.

7. The manufacturer shall submit a copy of the specifications with each sub-paragraph noted with the term, "compliance", "deviation", or "alternate".

    a. By noting the term "compliance" it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.

    b. By noting the term "deviation" it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.

    c. By noting the term "alternate" it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. Any alternate shall be fully described as to what the manufacturer proposes to provide.

E. Manufacturer Seismic Qualification Certification: Submit certification that the generator and associated equipment will withstand seismic forces as defined in ASCE 7. Refer to Division 26 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

    b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 QUALITY ASSURANCE

A. All components of and the complete installation of the diesel generator system shall comply with all applicable requirements of the National Electrical Code relating to emergency and standby power systems.

B. The diesel generator system shall conform to the applicable requirements of the following standards and authorities:

1. NFPA - 37 "Installation and Use of Stationary Combustion Engines and Gas Turbines"

2. NFPA 110 "Emergency and Standby Power Systems"

3. ANSI/NEMA Standards MG-1 and MG-2

4. Diesel Engine Manufacturer's Association (DEMA)

5. Electrical Generating Systems Marketing Association (EGSMA)

6. Environmental Protection Agency (EPA)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar

2. Onan/Cummins

3. Kohler

4. MTU Onsite Energy

2.2 ENGINE

A. Diesel fueled, compression ignition firing ("in-line" for under 600 KW and "vee" for 600 KW and above) type cylinder arrangement, 1800 RPM, water cooled with unit mounted radiator, jacket water heaters, mounting frames, and spring-type vibration isolators.

B. The engine shall be specifically designed to operate using #2 diesel fuel.

C. Engine shall be fully equipped with fuel, lube oil and air intake filters; lube oil coolers; fuel transfer pumps; fuel priming pump; flexible fuel lines; service meter; gear driven water pump; unit mounted instruments including a water temperature gauge, and lube oil pressure gauge; service indicators for air cleaner and fuel filter.

D. Provide and install a skid mounted, sub-base located diesel fuel storage tank of steel construction with a capacity for 48 hour runtime at 75% load. This fuel tank shall support the full weight of the unit. The tank shall be internally coated with corrosion inhibitor, and externally painted to match overall unit color. The fuel tank shall be equipped with a visual fuel gauge, 2 inch (50 mm) fill connection, full flow breather vent, and tank drain located at the opposite end to the fill connection. All piping connections to the equipment shall be made with flexible connectors. Provide a level switch for low level alarm circuitry.

E. Engine exhaust silencer shall be critical zone type, side inlet, inline outlet, flanged inlet and outlet connections to match engine exhaust outlet flanges, and flexible stainless exhaust connection section between engine and silencer.

F. Governor shall be electronic type, isochronous with manual and automatic speed control. Governor shall be capable of +/- 0.25% steady state frequency regulation. Speed shall be sensed by magnetic pickup off the engine flywheel.

G. Unit-mounted radiator, blower fan, engine-driven water pump, thermostat and radiator duct flange shall be provided. The cooling system shall cool the engine in a 125˚F (52˚C) ambient with up to 0.5 inches (13 mm) of water static pressure on the fan.

H. Shut-off devices and circuitry for high water temperature, low oil pressure, engine overspeed, engine overcrank, and high oil temperature shall be provided.

I. Jacket water heaters rated at 208/240V, 1-phase, with automatic thermostats shall be provided.

J. Provide summary alarm contacts (1 N.O. and 1 N.C. rated 10 amperes, 120 VAC) to operate on any one or combination of the following alarms: low oil pressure, high water temperature, overcrank, engine-generator control switch not in automatic and low DC voltage.

2.3 STARTING SYSTEM

A. Starting system shall be 24 volts DC, with positive engagement starting motor mounted on the engine.

B. The starting system shall include fully automatic and manual start-stop features. The system shall include overcrank lockout and shut down after five (5) ten-second cranking periods.

C. Provide 24 VDC lead-acid battery, heavy-duty diesel engine starting type. Battery shall be rated not less than 220 AH and shall provide 120 seconds of cranking power for the engine at the lowest ambient temperature to be encountered. Provide epoxy-treated steel battery rack, intercell and interior connectors, lugs and cables.

D. Battery charger shall be mounted, in a NEMA-3R enclosure, with float and equalizing charge rates to match battery manufacturer's requirements to maintain proper charge condition, current limiting with overload protective devices, silicon diode full wave rectification, voltage surge suppressor; DC ammeter and voltmeter (+/- 5 percent), fuse protected 120 volt single phase AC input, minimum 10 amp output. Provide low DC voltage alarm relay with one N.O. and one N.C. alarm contact.

2.4 GENERATOR

A. The generator shall be rated 450 KW, 562 KVA at 0.8 power factor, 480 volts, 60 HZ at 1800 RPM.

B. The generator shall be a three-phase, single bearing, 54°F (130°C) rise, synchronous type built to NEMA standards. Class F insulation shall be used on the stator and rotor, and no materials which will support fungus growth shall be used. The generator shall include a resettable protector for exciter/regulator protection against extended low power factor loads, and two-level heat detectors.

C. A generator-mounted, exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be

plus or minus 1/2% from no load to full rated load. Readily accessible voltage drop, voltage level, and voltage gain controls shall be mounted on the regulator. Voltage level adjustment shall be a minimum of plus or minus 10%. The solid-state regulator module shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration.

D. Generator shall be wye connected with an overspeed capability of 125% and less than 5% wave form deviation.

E. The generator shall be furnished with a series current boost system or a permanent, magnet exciter to force the field during short-circuit conditions. The generator shall be capable of sustaining a minimum of 250 percent rated current for ten (10) seconds under short-circuit conditions.

F. Provide a unit-mounted, enclosed molded case circuit breaker with adjustable long time and instantaneous trip settings and a short-circuit rating compatible with the rating of the generator.

G. Provide ground fault indication equipment. Ground fault relay shall be factory installed with a ground fault alarm lamp on the generator control panel. Provide a reset switch and test switch on the generator control panel. Provide one (1) set of form "C" contacts for remote monitoring.

2.5 CONTROL PANEL

A. Control panel shall be unit-mounted using vibration isolators. All controls shall be resistant to moisture and vibration.

B. Provide two-wire start-stop control for remote connection to ATS and local manual control. Provide three-position AUTO-OFF-RUN selector switch. In the AUTO position, start stop functions shall be controlled from the transfer switch system. In the OFF position, the unit shall not start under any conditions. In the RUN position, the unit shall start and run regardless of the status of the remote start circuit. All safety shut-off devices and circuits shall be operative in both the AUTO and RUN positions. The OFF position shall be used for reset of shut-off alarms.

C. The control panel shall include the following instrumentation:

1. Digital ammeter, voltmeter and frequency meter.

2. Digital power factor meter.

3. Frequency meter, pointer or digital type, +/- 2 percent, 45-65 Hz

scale.

4. Panel illuminating lights.

5. Running time meter, 0-9999 hours.

6. Battery charging meter.

7. Alarm panel to indicate low oil pressure, high water temperature, overcrank, overspeed, low battery voltage, low fuel. Provide audible alarm with silence pushbutton. Alarm panel shall satisfy NFPA 110, Level 2 requirements.

8. Engine start/stop selector switch.

9. Output voltage adjustment.

2.6 REMOTE ANNUNCIATOR PANEL

A. NFPA 110, Level 2 requirements for remote annunciation shall be satisfied by a remote mounted panel. Provide lamp test and alarm silence switches.

2.7 UNIT ENCLOSURE

A. Provide a weather-protective enclosure with mounted silencer for outdoor applications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall be completely responsible for installing the engine-generator in the space shown ensuring that code required working space is available around the equipment.

B. Provide control conductors (starting circuit) between transfer switch(es) and generator(s). Coordinate with transfer switch manufacturer and generator manufacturer as required. For emergency generator applications, control conductors installed between the transfer switch and the generator shall be as follows:

1. Control wire installation shall comply with NEC Article 700.10 (D)(3).

2. The control conductors shall be kept entirely independent of all other wiring and shall meet the conditions of NEC Article 700.10 (D)(1).

3. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

3.2 TESTING AND CERTIFICATION

A. After fabrication in the manufacturer's plant, an operational test shall be conducted to check out the entire system before delivery.

B. After installation, the manufacturer shall provide the services of a competent factory based service engineer to coordinate the installation of the engine generator system. He shall assist in placing the equipment into operation and provide instruction as required to the person or persons who are delegated to operate the equipment.

C. The manufacturer of the generator shall inspect and verify the correct installation of the generating system. All individual components including, but not limited to, the engine, generator, fuel tank, battery, battery charger, and silencer shall be checked. Power conductors and control circuits shall also be checked.

D. The manufacturer of the generator set shall provide the services of a qualified technician for initial start-up. Checks and services shall be conducted to prepare all equipment for start-up. All alarm circuits and safety shutdown circuits shall be checked. The technician shall follow a routine start-up procedure as recommended by the equipment manufacturer.

E. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

F. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified, including, but not limited to, single-step full-load pickup test. Provide load bank as necessary.

G. Coordinate tests with tests for transfer switches and run them concurrently.

H. Field service must be unlimited and must continue until satisfactory system operation and customer approval has been achieved.

I. Operating and maintenance instructions shall be provided. Instructions shall be provided in accordance with Division-26 Section, Basic Electrical Materials and Methods.

J. The manufacturer shall warrant the equipment specified herein to be free from defects in material or workmanship. In the event any defects are discovered within 24 months from start-up or 30 months from date of delivery, the manufacturer shall perform repairs or replacement, at its own option, of any defective products at no cost to the Owner.

3.3 FUEL

A. At the conclusion of the project, after all testing is complete and the generator has been accepted by the Owner, the fuel tank must be filled to capacity. All fuel consumed during testing must be replaced and the tank must be full.

END OF SECTION

SECTION 26 3600 - AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this Section.

1.2 SUMMARY

A. This specification describes the requirements associated with the automatic transfer switches and associated control devices as indicated on the drawings and as specified herein. The automatic transfer switches shall be manufactured, installed and tested in strict accordance with these specifications.

B. Automatic transfer switches associated with fire pumps shall be supplied as an integral part of the fire pump controller. These switches shall be as specified in Division-21.

1.3 SUBMITTALS

A. Submit the following information for Owner/Engineer review, comments and/or approval:

1. Product data.

2. Complete installation drawings, including plan view and elevations with connection of required utilities clearly indicated.

3. Electrical schematics, wiring diagrams, interconnection diagrams and bussing details.

4. Statement of compliance and deviation as specified herein.

B. The manufacturer shall submit a copy of these specifications with each sub-paragraph noted with the comment "compliance", "deviation", or "alternate".

1. By noting the term "compliance", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.

2. By noting the term "deviation", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.

3. By noting the term "alternate", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. Any alternate shall be fully described as to what the manufacturer proposes to provide.

C. Identify all specified items on submittals to assure compliance and ease of review and/or approval.

D. Manufacturer Seismic Qualification Certification: Submit certification that the automatic transfer switches will withstand seismic forces as defined in ASCE 7. Refer to Division 26 Section "Seismic and Wind Controls." Provide one of the following:

1. Analysis: Calculation by a Professional Engineer demonstrating compliance with ASCE 7 Chapter 13.

2. Equipment Certificate: Certificate must show equipment has been tested based on a nationally recognized testing standard procedure. Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Experience Data: Provide experience data acceptable to the local Authority Having Jurisdiction which demonstrates the seismic capacity of components and their supports in accordance with ASCE 7 Chapter 13.

4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 QUALITY ASSURANCE

A. The automatic transfer switches shall conform to these specifications and

applicable codes and standards published by the following authorities and associations:

1. National Fire Protection Association (NFPA)
2. Underwriter Laboratories (UL), UL 1008
3. NFPA 70, National Electrical Code (NEC)
4. American National Standards Institute (ANSI)
5. National Electrical Manufacturers Association (NEMA)
6. American Society of Testing and Materials (ASTM)
7. Institute of Electrical and Electronics Engineers (IEEE)

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

A. The automatic transfer switch shall be factory assembled with the current ratings, voltages and accessories as indicated on the drawings or specified herein.

B. The switch and all of its associated controls and terminations shall be completely front accessible.

C. The switch shall be mechanically held in both the normal and the emergency positions, and rated for continuous duty in an unventilated enclosure. The switch shall be open transition, break-before-make, double throw with the main contacts rigidly and mechanically interlocked to insure three possible positions: Normal, Emergency or Neutral.

D. The automatic transfer switch shall be of the motor or solenoid type. Circuit breaker type switches are not acceptable and will not be considered.

E. The ATS shall be UL listed, STD UL-1008, with withstand and close-in values which match the overcurrent protective devices for the normal and emergency feeders.

F. The ATS shall be provided in a NEMA type 1 enclosure suitable for the location where the switch will be installed.

G. All bus shall be copper.

H. The ATS shall be four-pole. The four-pole switches shall have ratings identical to the other poles and shall be mounted on the same shaft. Reduced neutral ratings, overlapping neutral contacts and switches which are not true four-pole switches shall not be acceptable.

I. The ATS shall have a withstand rating equal to the AIC ratings of the circuit breakers from which it is served.

2.2 ACCESSORIES

A. The ATS shall be provided with the following accessories:

1. Adj. 0.5-3 second time delay on engine start.

2. Adj. 1-300 second time delay on transfer to emergency.

3. Adj. 0-30 minute time delay on transfer to normal.

4. Fixed 5 minute time delay for engine cool-down.

5. Load test switch, maintained type.

6. One (1) contact to open and one (1) contact to close on failure of normal to be used for engine starting.

7. Pilot lights to indicate switch position.

8. Two (2) auxiliary contacts closed in normal.

9. Two (2) auxiliary contacts closed in emergency.

10. Adjustable close differential voltage sensing on all phases of normal, pick-up set at 90%, drop-out set at 85% of nominal.

11. Voltage and frequency sensing of emergency source, voltage pick-up set at 90%, frequency pick-up set at 95% of nominal.

12. An automatic seven (7) day exerciser clock, enabling the engine to be automatically started and run without load for thirty (30) minutes each week at a preprogrammed time period. The transfer switch shall remain in the "normal" position unless a commercial power failure occurs during the exercise period.

13. An additional set of main-shaft auxiliary contacts (1 N.O. and 1 N.C.)

and two (2) time delay contacts for connection to the elevator controllers. The time delay contacts shall open twenty (20) seconds (adjustable 1-300 seconds) before transfer in either direction and reclose after transfer is complete.

B. The ATS shall have an open transition time between the opening of the closed contacts and the closing of the open contacts adjustable from 1-300 seconds.

C. The ATS shall be equipped with a safe manual operator. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator. The manual operator shall be operable with the ATS door in the closed position.

D. All relays, timers, control wiring shall be front accessible. All adjustable time delays shall have calibrated marks for field adjustments. Time delay relays/circuits which cannot be accurately set in the field without the use of test equipment are not acceptable.

2.3 OPERATION

A. Upon loss of normal power and after an adjustable time delay, the switch shall signal the standby generator to start.

B. The transfer switch shall transfer to emergency when the output of the standby generator reaches 90% of rated voltage and 95% of rated frequency. If the emergency source is not available, or if the generator voltage is less than 90% nominal, transfer to emergency shall be inhibited.

C. After the normal source has been restored to 90% of rated voltage, the transfer switch shall retransfer to the normal source after an adjustable time period of 0 to 30 minutes.

D. The standby generator shall continue to run unloaded for five (5) minutes and then shutdown. All controls shall automatically reset in preparation for the next power failure.

2.4 BYPASS-ISOLATION SWITCHES

A. Provide factory-assembled, manually operated, bypass-isolation switches and all auxiliary equipment required for complete operation.

B. The bypass-isolation switch shall allow the load to be transferred to either source regardless of the position of the ATS. Positive sequencing of all contacts shall be accomplished using external manual operators.

C. The bypass-isolation switch shall permit complete testing and maintenance of the ATS. When the switch is in the bypass position, the load shall be connected to the normal or emergency source, and the ATS shall be energized for testing. When the switch is in the isolation position, the load shall be connected to either the normal or the emergency source, and the ATS shall be isolated from all sources of supply for maintenance.

D. The bypass-isolation switch shall have the same electrical ratings as the ATS with respect to current rating, voltage, frequency, poles, withstand and close-in. The switch shall be of the load break type.

E. The bypass-isolation switch shall be installed in the same enclosure as the ATS and shall be by the same manufacturer as the ATS.

F. The bypass-isolation switch shall have the necessary controls to ensure that the engine start contacts remain closed when the load is bypassed to the emergency source.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the automatic transfer switches in the space shown.

B. Connect auxiliary and control contacts in ATS to the elevator controllers in accordance with the elevator manufacturer's instructions.

C. Connect auxiliary and control contacts in ATS to the engine-generator control panel in accordance with the engine-generator manufacturer's instructions. For emergency generator applications, control conductors installed between the transfer switch and the generator shall be as follows:

1. Control wire installation shall comply with NEC Article 700.10 (D)(3).

2. The control conductors shall be kept entirely independent of all other wiring and shall meet the conditions of NEC Article 700.10 (D)(1).

3. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

D. Connect auxiliary and control contacts in ATS to the fire alarm

annunciators and controls in accordance with the fire alarm instructions.

3.2 TESTING AND CERTIFICATION

A. Test and demonstrate to the Owner's representative (with factory representative present) that the transfer switch meets the requirements of this specification.

B. Demonstration shall include, but not be limited to, the operation of all time delays, starting contacts, and transfer functions.

C. All testing shall be scheduled at the convenience of the Owner, and shall be arranged at least two (2) weeks in advance.

D. Services shall include a minimum of two (2) visits by representatives of the ATS manufacturer as follows:

1. Following installation, the manufacturer of the ATS shall inspect and verify the correct installation of the ATS. All individual components shall be checked. Power conductors and control circuits shall also be checked.

2. The manufacturer of the ATS shall provide the services of a qualified technician for initial start-up. Checks and services shall be conducted to prepare equipment for energization.

3. Field service must be unlimited and must continue until satisfactory system operation and customer approval has been achieved.

4. Prior to system turnover, an instruction period for operation shall be provided.

E. Final data sheets, schematics, dimensional drawings, and operating and maintenance instructions shall be provided. This information shall be provided in the operating and maintenance manuals specified in Division-26 Section, Basic Electrical Materials and Methods.

END OF SECTION

SECTION 26 4113 - LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this Section.

1.2 SUMMARY

A. The Contractor shall furnish all labor and materials to furnish and install a UL-listed Master-Labeled lightning protection system for the structure or structures to be constructed under this Contract. The lightning protection system shall incorporate all roof-top equipment.

B. The Contractor shall furnish all labor and materials to furnish and install a UL-listed lightning protection system for all new roof-top equipment located on an existing roof. The Contractor shall extend the existing lightning protection system to incorporate the new equipment.

1.3 SUBMITTALS

A. Submit product data for each component of the lightning protection system.

B. Submit shop drawings indicating air terminal locations, secondary conductor requirements, number and routing of main conductors, locations and details of ground rod installation, and other installation details and instructions.

C. Roof plans shall be at 1/8 inch (3 mm) or 1/4 inch (6 mm) scale, site plans shall be at 1 inch (25 mm) equals 20 feet (6 m).

D. Computer (CADD) files of electrical drawings will not be made available to the Contractor for any purposes.

1.4 QUALITY ASSURANCE

A. The Contractor shall engage an UL-Listed Installer to install the lightning protection system. The name of the Installer and evidence of current UL-listed status shall be furnished with the submittal data.

B. All lightning protection system components and the installation of the lighting protection system shall comply with the following codes and standards:

1. NFPA 70, National Electrical Code
2. NFPA 780, Lightning Protection Code
3. UL 96, Lightning Protection Components
4. UL 96A, Installation Requirements for Lightning Protection Systems
5. ANSI C2, National Electrical Safety Code
6. LPI-175, Lightning Protection Installation Standard
7. LPI-176, Lightning Protection System Material and Components Standard
8. LPI-177, Inspection Guide for LPI Certified Systems
9. LPI - Lightning Protection Institute

C. A copy of the submittal data shall be sent to, reviewed by, and approved by the Owner's underwriters for the referenced project.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION COMPONENTS

A. Lightning protection system components shall include, but not be limited to:

1. Air terminals
2. Bonding plates
3. Conductors
4. Connectors, splices and clamps
5. Ground rods

B. Lightning protection system components shall comply with UL 96A. All components shall be listed and labeled where available.

C. Conductors shall be stranded copper. All down leads shall be copper.

D. Air terminals shall be solid copper and shall extend at least 18" (450 mm) above the object to be protected.

E. Ground rods shall be minimum 5/8 inch (16 mm) diameter, 10 feet long (3 m). Ground rods shall be copper clad steel.

F. The use of combinations of materials which accelerate corrosion through electrolytic action is prohibited. Conductors and components shall have protective coatings where installation or unusual service conditions may cause deterioration.

G. The structural steel columns on the outside perimeter of the building may be utilized as the main down conductor from roof to ground. No other parts of the structural steel structure shall substitute for lightning protection conductors. The steel columns used shall not average over 60 feet (18 m) apart. The top of each column used shall be connected to the roof perimeter conductor. The bottom or lowest accessible point of each column shall be connected to a ground rod. All connections to steel shall be exothermic welds.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the lightning protection system in strict accordance with the manufacturer's written instructions and the approved shop drawings.

B. Splices and connections between conductors and other system components shall be made using exothermic welded connections.

C. Connections shall comply with the requirements of Division-26 Sections, “Electrical Connections” and “Grounding”, except as modified herein.

D. Inspections shall be performed in accordance with LPI-177.

E. Installation shall be UL inspected.

3.2 CERTIFICATION

A. The installation inspections shall be documented in accordance with LPI-177. Documentation shall be included in the Operating Instructions and Maintenance Manuals specified in Division-26 Section, “Basic Electrical

Materials and Methods".

B. A UL Master Label shall be furnished to the Owner's representative. A copy of the UL Master Label shall be included in the Operating Instruction and Maintenance Manual specified in Division-26 Section, "Basic Electrical Materials and Methods".

END OF SECTION

SECTION 26 4313 - INTEGRATED SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, Basic Electrical Materials and Methods, apply to this section.

1.2 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings and modifications as specified herein and/or as shown on the contract drawings. To maximize performance and reliability, and to obtain the lowest possible let-through voltages, the AC surge protection is to be integrated into electrical distribution equipment such as switchgear, switchboard, panelboard, busway and/or motor control center, or as shown on the contract drawings.

1.3 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards

1. ANSI/UL 1449 4th Edition or later
2. ANSI/UL 1283 5th Edition or later (Type 2 applications)
3. IEEE C62.41.1
4. IEEE C62.41.2
5. IEEE C62.43-2005
6. IEEE C62.45-2002
7. IEEE C62.48-2005
8. IEEE C62.62-2010
9. UL 96A

10. NFPA 780

1.4 SUBMITTALS

A. Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website www.ul.org, the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current In.

1. Descriptive bulletins.

2. Product sheets.

3. Final record drawings.

1.5 QUALIFICATIONS

A. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the listed electrical distribution equipment.

B. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.

E. The SPD shall be UL 1449 current edition listed, 20 kA In Type 1 or Type 2 for use in UL 96A systems.

F. The manufacturer must have a 24-hour response capability with field engineering personnel. The field service organization must have fully accredited Power System Engineers located across the USA who are capable of performing complete grounding, Power Quality analysis, and coordination studies. Factory trained SPD sales personnel do not qualify

as Power System Engineers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton, Cutler-Hammer or approved equivalent.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements:

1. Unit Operating Voltage: Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV): The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode is not acceptable.

4. Unit shall operate without the need for an external overcurrent protection device (OCPD), and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.

5. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split	●	●	●	●

Phase				
High Leg Delta	●	●	●	●

6. Nominal Discharge Current (In): All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

7. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR): The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277
L-N; L-G; N-G	700	1200
L-L	1200	2000

B. SPD Design:

1. Maintenance Free Design: The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter: Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

   a. Type 2 units with filtering shall conform to UL 1283 5th Edition.

b. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.

4. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

5. Monitoring Diagnostics: Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators: Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

      2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes

      3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

   b. Remote Status Monitor (optional) – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

   c. Audible Alarm and Silence Button (optional) – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. Surge Counter (optional) – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Thermal MOV Protection:

a. The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design: All of the SPD's components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements:

a. The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs

requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.3 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity: The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards)	120 kA	60 kA

2.4 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes, in the case a disconnect is required.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

2.5 SERVICE ENTRANCE REQUIREMENTS

A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

3.3 INSTALLATION

A. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes and the contract drawings.

3.4 WARRANTY

A. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit, including lightning, from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.

END OF SECTION

SECTION 26 5100 - LIGHTING FIXTURES (LED)

PART 1 - GENERAL

1.1 SUMMARY

A. This section provides general requirements for a complete and fully operational lighting system including:

1. Interior lighting fixtures
2. Exterior lighting fixtures
3. LED modules
4. Drivers
5. Accessories
6. Light fixture support

1.2 RELATED SECTIONS

A. Basic Materials and Methods

B. Wiring Devices

C. Grounding

D. Supporting Devices

E. Lighting Control Systems

1.3 REFERENCES

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and Sections under Division-01 General Requirements.

B. Conform to Reference Standards by date of issue current on date of Contract Documents, except where a specific date is established by code.

1. ANSI/NFPA 70 National Electrical Code

2.	NFPA 101	Life Safety Code
3.	UL 57	Electrical Luminaires
4.	UL 496	Lampholders
5.	UL 924	Emergency Lighting and Power Equipment
6.	UL 1472	Solid-State Dimming Controls
7.	UL 773	Plug-In Locking Type Photo controls for Use with Area Lighting
8.	UBC	Standard Section 47.1813 Luminaires
9.	IES LM-79	Electrical and Photometric Measurements of Solid State Lighting
10.	IES LM-80	Method for Measuring Lumen Maintenance for SSL Light Sources

1.4 SYSTEM DESCRIPTION

A. The Lighting Fixture Schedule and catalog numbers indicated are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, lumen output, Color Rendering Index (CRI), color temperature (CCT), driver, finish trim, ceiling type, mounting hardware, or special requirements as specified or as required by the particular installations. Provide complete fixture to correspond with the features, accessories, lumen output, wattage and/or size specified in the text description of each fixture type. Additional features, accessories and options specified shall also be included to provide a complete and operable system.

B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed fixtures shall have frames that are compatible with the ceiling systems.

C. Light fixture voltage shall match the voltage of the circuit serving the light fixture.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to

conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

B. 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.

C. Comply with applicable requirements of local codes and NEC Articles 220 and 410 as applicable to construction and installation of lighting fixtures.

D. Comply with applicable NEMA, IES and UL standards. Lighting fixtures and components shall be UL listed and labeled.

E. Comply with NFPA 70.

F. Factory Mutual Global (FMG) Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

G. Luminaires, drivers, LED modules/sources and other components and controls shall equal or exceed the requirements of all applicable state and/or municipal energy codes.

H. Designated manufacturers are listed to define the requirements for quality and function of the specified product. Equivalent or better products of other, unnamed manufacturers may be proposed for consideration by adhering to procedures set forth in this section and in other Division-01 specification sections.

1.6 SUBMITTALS

A. Comply with requirements of specification section describing Submittal Procedures. Also, refer to the electrical specification section, Basic Materials and Methods, for re-submittal requirements.

B. The authorized manufacturer's representative for the project area shall prepare submittals for each lighting fixture type. In addition to the fixture submittals, a list shall be provided identifying the manufacturer representative for each fixture type. Provide manufacturers' names, addresses, and telephone numbers.

C. Light fixture submittals shall include the total fixture maximum input wattage, including driver and/or power supply losses for each and every fixture in one submittal package. This information shall be clearly indicated in the submittal. The lighting fixture submittal package will not

be reviewed until this information is submitted as required. Input wattage shall not exceed the maximum allowable total input watt value shown in the lighting fixture schedule.

D. Light fixtures shall be coordinated with project specific lighting control system devices. Provide a letter/statement in the lighting fixture submittal confirming that all lighting fixtures have been coordinated with the specific lighting control system devices that will be used on this project.

E. Product Data shall indicate that light fixture, lumen output, CCT, CRI, driver, input watts, and controls fully comply with contract documents. Data shall be submitted for each type of light fixture indicated, arranged in order of fixture designation. For standard catalog fixtures provide original product catalog sheets indicating data on features, accessories, finishes, and the following:

1. Materials and dimensions of luminaires.

2. Photometric data, in IES format, based on certified results of laboratory tests of each light fixture type, outfitted with LED modules/sources, drivers, and accessories identical to those indicated for the light fixture as applied in the Project.

    a. Photometric data shall be certified by a qualified independent testing agency.

    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

3. Emergency lighting unit battery and charger.

4. Low voltage transformers.

5. LED drivers and power supplies.

6. LED modules, including manufacturer, drive current, CRI, and CCT.

F. Shop Drawings shall:

1. Show details of nonstandard or custom fixtures.

2. Indicate dimensions, weights, method of field assembly, components, features, and accessories.

3. For custom fixtures, modified fixtures, or linear fixtures mounted in continuous rows, submit scaled drawings prepared by the

manufacturer showing all details of construction, lengths of runs, pendant and power feed locations, accessories, finishes, and lists of materials.

4. Contractor to provide the manufacturer with accurate field dimensions where required.

5. Include wiring diagrams, power and control wiring.

G. Wiring Diagrams shall detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

H. Product Certificates shall be signed by manufacturers of lighting fixtures certifying that products comply with requirements.

I. Dimming Driver Compatibility Certificates shall be signed by the manufacturer of driver certifying that drivers are compatible with dimming systems, equipment and controls with which they are used. Product certificates signed by the product manufacturer shall be provided for each type of driver for bi-level and dimmer controlled fixtures.

J. Provide confirmation of approval by both the manufacturer of dimming LED fixtures and manufacturer of dimming control components that their products will meet specified performance criteria and warranty when used together.

K. Maintenance Data shall be provided for lighting fixtures and equipment to include in emergency, operation, and maintenance manuals specified in specifications section describing Operations and Maintenance Data.

L. Field quality control test reports.

M. Special Warranties specified in this Section.

N. Review of luminaire submittals which indicate voltage, mounting condition, or quantities shall not be considered to be approval of said voltage, mounting condition, or quantities. Contractor shall field verify voltage and actual mounting condition and method.

O. Product samples, complete with housing, trim, LEDs, and 8' cord with plug wired for 120V operation shall be submitted if requested.

1.7 SUBSTITUTIONS

A. Substitutions shall include all information required under in paragraph 1.06

- SUBMITTALS.

B. Equipment delivery lead time shall not be held as a valid reason for submitting a luminaire substitution. It shall be the sole responsibility of the Contractor to determine necessary equipment lead times, deliver submittals for review in a timely fashion, and place orders accordingly to ensure timely delivery.

C. Submittal for Product Substitutions: All products submitted which are other than the make and model called out in the Construction Documents are considered "Substitutions". The Contractor must submit the following for all substitutions:

1. Provide cut sheet/product data for substitute item, including list price.

2. Provide cut sheet/product data for specified item, including list price.

3. Provide point-by-point photometric calculations using the substitute light fixture(s) for the entire project area or portions thereof as directed by the Engineer. The Contractor is responsible for contacting the Engineer to obtain the required calculation parameters. Point spacing, total light loss, work plane height, and other parameters shall be provided upon request in order to match the Engineer's photometric model. Submittal review will be withheld until photometric calculations for substitutions are received.

4. When requested by the Engineer, provide a light fixture sample of the specified fixture and the substitute fixture for comparison. Samples shall be complete with cord/plug for 120V operation.

5. It is the Contractor's responsibility to prove that substitutes are "equal".

6. Confirm that controls are compatible with substitute light fixtures.

7. Confirm that energy code requirements are met when using the substitute fixtures.

8. Redesign is the responsibility of the contractor.

D. A maximum of one substitution requests shall be reviewed for any single fixture type. If a substitution has not been approved following this process, the Contractor shall provide the specified fixture.

1.8 COORDINATION

A. Coordinate layout and installation of light fixtures with ceiling system and other construction that penetrates ceilings or is supported by them including mechanical system, fire suppression, AV, and partition assemblies.

B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed fixtures shall have frames that are compatible with the ceiling systems.

C. Coordination Meetings: Meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area. Meet at least twice with the mechanical systems installer prior to fabrication and installation of ductwork. Coordinate depth and location of all light fixtures and ductwork in all areas.

1.9 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty for LED Lighting Fixtures: A warranty must be provided by the manufacturer made out to Owner for luminaires, covering repair or replacement of defective electrical parts (including light engine, driver and power supplies) within specified warranty period indicated below.

1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Contractor shall include [5] exit light fixtures, in addition to the fixtures shown on the drawings, inclusive of associated labor and material to install after final walk-thru by Fire Marshal. Devices shall be installed in locations as directed by Fire Marshal, and shall include all cutting, patching and finishing of walls. All unused fixtures shall be turned over to the owner for use as spares.

B. Furnish extra materials described below, or as described in the Lighting

Fixture Schedule, that match product installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Glass and Plastic Lenses, Covers, Louvers, and Other Optical Parts: 10% or one dozen (whichever is less) of each type and rating installed. Furnish at least one of each type.

2. Globes and Guards: 5% of each type and rating installed. Furnish at least one of each type.

3. LED light engines, drivers, and power supplies: 10% extra individual modular LED strips or replaceable source modules, drivers and power supplies. If product does not have replaceable components, furnish at least 10% extra entire fixture assembly. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Catalog series numbers shown on the Lighting Fixture Schedule on the drawings represent the type and style of fixture. The fixture size shall correspond with the actual length of the fixture as indicated on the drawings.

B. Numbers are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, CCT, CRI, type of driver, finish trim, ceiling type, mounting hardware or special requirements as specified as required by the particular installations. Acceptable manufacturers and series numbers are listed. The manufacturer listed shall provide complete fixtures equaling or exceeding the written specifications. Verify these requirements and order fixtures as required for a complete and fully operational installation per the contract documents and per code.

2.2 GENERAL MATERIAL REQUIREMENTS

A. Fixtures shall be free of light leaks while providing sufficient ventilation of LED sources to provide the required photometric performance. Drivers and transformers/power supplies shall be adequately vented.

B. Lampholders shall hold lamps securely against normal vibration and maintenance handling.

C. Light fixtures which require protective shielding shall be furnished with a tempered glass lens or approved unbreakable lens UL listed for the application.

D. Metal parts shall be free from burrs, sharp corners, and edges. Metal work shall be free from tool marks and dents and shall have accurate angles bent as sharply as compatible with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All miters shall be in accurate alignment with abutting intersection members.

E. Sheet metal components shall be steel, unless otherwise indicated. Components shall be formed and supported to prevent warping and sagging. Luminaires to be painted after fabrication. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.

F. Fixture hardware to comply with the following material standards: For steel and aluminum fixtures, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. For bronze fixtures, all hardware shall be stainless steel or bronze.

G. Doors, frames, and other internal access shall be smooth operating, and free from light leaks under normal operating conditions.

H. Provide supplemental safety device or arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during maintenance and when secured in operating position. Safety devices shall be detachable if necessary and shall not interfere with fixture performance, maintenance, or the seating of any fixture element. Safety device shall not be visible during normal fixture operation and from normal viewing angles.

I. Luminaires provided must have means for disconnection from power during service, as required in the NEC Article 410.

J. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 90 %.

2. Specular Surfaces: 90 %.

3. Diffusing Specular Surfaces: 75 %.

4. Laminated Silver Metalized Film: 90 %.

K. Reflector cones shall adhere to the following criteria:

1. Plastic material shall not be used for reflector cones, unless otherwise specified.

2. Unless otherwise specified, cones shall not be permanently fastened to the housing or ceiling and shall be removable without tools. Retention devices shall not deform the cone or be visible from normal viewing angles.

3. Trim shall be flush to the finished ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the reflector cone.

4. Reflector cones shall be of uniform gauge, not less than 0.032" thick, high purity aluminum Alcoa 3002 alloy. Cones shall be free of spin marks or other defects.

5. Manufacture cone using the Alzak process. Refer to the fixture schedule for cone color and finish (i.e. specular or diffuse) requirements.

L. Lenses, Diffusers, Covers, and Globes shall be 100 % virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic, polycarbonate and acrylic shall be UV stabilized and shall have high resistance to yellowing and other changes due to aging, exposure to heat and ultraviolet radiation.

2. Lens Thickness shall be 0.125" (3 mm) unless other thickness is indicated.

3. Lenses shall have uniform brightness throughout the entire visible area.

M. Adjustable light fixtures shall have positive locking devices to fix the aiming angle.

N. Each lighting fixture having an oval shape beam pattern or a spread lens that defines beam orientation shall contain locking devices to insure that orientation is not disturbed during future maintenance or cleaning.

O. All fixtures and drivers must operate within the temperature limits of their design and as specified by Underwriters' Laboratories, Inc. in the applications and mounting conditions herein specified.

P. Fixtures recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article

300-22.

Q. Provide plaster frame for recessed light fixtures mounted in other than T-bar ceilings. Verify mounting with architectural reflected ceiling plan before ordering light fixtures.

R. Provide wire guards where specified.

S. For weatherproof or vaportight installations, painted finishes of fixtures and accessories shall be weather resistant enamel using proper primers or galvanized and bonded epoxy, so that the entire assembly is completely corrosion resistant for the service intended. Exterior finishes shall have an outdoor life expectancy of not less than 20 years without any visible rust or corrosion. Where aluminum parts come into contact with bronze or steel parts, apply a coating material to both surfaces to prevent corrosion.

T. Fixtures for use outdoors or in areas designated as damp locations shall be suitably gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation openings. Dissimilar metals shall be separated by non-conductive material to prevent galvanic action.

U. Welding shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surface will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. Remove weld spatter and welding oxides from all welded surfaces.

V. Electromagnetic-Interference Filters shall be factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate light fixtures with one filter on each driver indicated to require a filter.

2.3 LIGHT EMITTING DIODE (LED) FIXTURES

A. All Luminaires:

1. Comply with IES LM79 and IES LM80 LED product testing procedures, and DOE Energy Star criteria.

2. Luminaires shall not draw power in the off state. Luminaires with

integral occupancy, motion, photo-controls, or individually addressable fixtures with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.

3. Color spatial uniformity shall be within .004 of CIE 1976 diagram.

4. Color maintenance over rated life shall be within .007 of CIE 1976.

5. White LED luminaires shall achieve a minimum CRI of 80, and R9 value above 24, and Binning of white LEDs used in the luminaires shall fall within a 3-step MacAdam ellipse minimum, or as indicated in the Lighting Fixture Schedule.

6. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management

7. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver at least 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.

B. Power Supplies and Drivers:

1. Power Factor 0.90 or higher

2. Operating temperature: minimum of -20°C or below when used in luminaires intended for outdoor use.

3. Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.

4. Output operating frequency: 120Hz.

5. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.

6. Total Harmonic Distortion Rating: Less than 3%, or as specified in the Light Fixture Schedule.

7. Meet electrical and thermal conditions as described in LM-80 Section 5.0.

8. Primary Current: Confirm primary current with Electrical Drawings.

9. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.

10. Compatibility: Certified by manufacturer for use with individually

specified luminaire and individually specified control components.

11. Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

C. Controller and Control System:

1. System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required

2. Contractor to ensure that external control equipment is compatible with LED control requirements

3. Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.

4. For control components that are part of overall area control system see Electrical Dimming Controls specification.

5. For stand-alone controlled LED systems see the Lighting Fixture Schedule.

6. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers.

2.4 SELF-BALLASTED LED LAMPS

A. Provide products manufactured by one of the following: Osram/Sylvania, General Electric, Philips, Ushio, Venture, or approved equal.

B. All lamps of the same type are to be provided by the same manufacturer.

C. Lamp each fixture with the proper quantity of lamps of the type specified in the Lighting Fixture Schedule.

2.5 WIRING

A. All wiring shall be as required by code for fixture wiring.

B. All flexible cord wiring between fixture components or to electrical receptacles and not in wireways shall have a minimum temperature

rating of 105 degrees Celsius.

C. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.

D. No internal wiring shall be visible at normal viewing angles.

2.6 FIXTURE SUPPORT COMPONENTS

A. Comply with specification sections describing Basic Materials and Methods and Supporting Devices for fixture support and bracing.

B. Where the ceiling is of insufficient strength to support the weight of the lighting fixtures, provide additional framing from building structure to support luminaires as required. Do not support fixtures from ceiling T-Bar system.

C. Single-Stem Hangers shall be 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish shall be the same as the luminaire.

D. Twin-Stem Hangers shall be two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish shall be the same as the luminaire.

E. Rod Hangers shall be 3/16-inch minimum diameter, cadmium-plated threaded steel rod.

F. Wires shall be ASTM A 641/A 641M, Class 3, soft temper, zinc coated steel, 12 gauge.

G. Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge.

H. Hook Hangers shall be integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

I. Aircraft Cable Support shall use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

J. Hangers for Pendant Industrial Fixtures shall be heavy duty No. 8 jack chain with hangers, "S" hooks, mounting, straps, and all required accessories for complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials.

B. Mounting height indicated in drawings from finished floor to bottom of pendant light fixture or to the center of the outlet box for wall mounted light fixtures unless otherwise noted. Verify mounting heights with Architect and Engineer.

C. Mounting height may also be indicated as the length of the pendant below finished ceiling.

D. Verify weight and mounting method of all fixtures prior to ordering and provide suitable support. Coordinate with General Contractor for fixtures that require additional blocking or support and provide required support. Fixture mounting assemblies shall comply with all local seismic codes and regulations.

E. Refer to architectural reflected ceiling plans for coordination of light fixture locations with mechanical and fire safety equipment. Where conflicts occur, coordinate with Architect and Engineer prior to installing any of the systems.

F. In accessible suspended ceilings, fixture wiring connection, including equipment grounding conductor, shall be through use of 72-inch (max. length) flexible conduit from a rigidly supported junction box, unless noted otherwise.

G. Wire per requirements of branch circuit installation. Properly ground each fixture.

H. Light fixtures located in recessed ceilings with a fire resistive rating of 1 hour or more shall be enclosed in an approved fire resistive rated box equal to that of the ceiling.

I. Install fixtures with vent holes free of air blocking obstacles.

J. Contractor shall be responsible for adjusting aperture flanges or rings on all recessed fixtures to be flush with the finished ceiling. Fixture trim shall completely conceal ceiling opening.

K. Adjust variable position lampholders for proper lamp position prior to fixture installation.

3.2 FIXTURE SUPPORT

A. Comply with specification sections describing Basic Materials and Methods and Supporting Devices for fixture support and bracing.

B. Provide all necessary hanging or mounting devices for all fixtures, verify the type needed for various ceiling conditions. Plaster rings shall be provided where required.

C. Ceiling Fixture Support: Where ceiling is of insufficient strength to support weight of light fixtures installed, provide additional framing from building structure to support as required.

D. Provide a minimum of two safety wire hangers or threaded rods for each recessed mounted fixture. Secure from opposite corners of each fixture and fasten to structure above, independent of ceiling system. Locate supports not more than 6 inches from fixture corners.

E. Fixtures which are of a size smaller than the ceiling grid shall be located as indicated on the reflected ceiling plans. Fixtures shall be supported independently of the grid ceiling with at least two ¾ inch metal channels spanning and secured to the ceiling tees.

F. Metal decking shall not be pierced for luminaire support.

G. Where pendants or rods are longer than 48 inches, brace to limit luminaire swinging.

H. Brace suspended luminaires installed near ducts or other elements so that they do not swing into obstructions.

I. Wall mounted light fixtures shall be supported from four-square outlet box plaster ring and from wall at non-feed end with two 1/4-inch toggle bolts for gypsum board walls or 1/4-inch bolts to pre-set inserts for concrete wall.

3.3 LED FIXTURES

A. Adhere to manufacturers installation guidelines regarding proper thermal management.

3.4 LIGHTING CONTROL

A. Provide branch circuiting in coordination with lighting control requirements of specification section describing lighting control equipment and as indicated on Electrical Drawings.

3.5 CLEANING AND ADJUSTING

A. Remove protective plastic covers from light fixtures and fixture diffusers only after construction work, painting and clean-up are completed. Remove, clean, and reinstall all dirty lamps, reflectors and diffusers.

B. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer for cleaning Alzak reflectors, anti-microbial finishes, and other surfaces.

C. Make final adjustment of aimable light fixtures and adjustable light settings under the direction of the Engineer during a scheduled period of time prior to the completion of the project, after normal business hours if required. Include all equipment and personnel expenses including overtime required for focusing.

D. Fixtures, reflectors, and accessories which are damaged, blemished, or impregnated with fingerprints shall be replaced at the contractor's expense. All finishes shall be unmarred upon project completion.

3.6 FIELD QUALITY CONTROL

A. Coordinate all testing procedures and schedule with the specification section describing Inspections, Testing and Start-up. All testing is to be documented with test procedures, results and initials of witnessing personnel and submitted to the Engineer and included in the O&M Manual.

B. Coordinate inspection and testing of Lighting Fixtures with specification section for lighting control equipment.

C. Inspect each installed fixture for damage. Replace damaged fixtures and components.

D. Replace all inoperative LED modules and/or sources at the end of construction prior to Owner occupancy.

E. Advance Notice: Give dates and times for field tests.

F. Provide instruments to make and record test results.

G. Test as follows:

1. Verify proper operation, switching and phasing of each fixture after installation.

2. Emergency Lighting: Interrupt electrical supply to demonstrate

proper operation. Verify normal transfer to generator and retransfer to normal.

3. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to the lighting system, retest to demonstrate compliance with standards.

H. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

END OF SECTION

SECTION 26 5720 - TELEPHONE AND DATA SYSTEMS SUPPORT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and Division-26 Section, "Basic Electrical Materials and Methods", apply to this Section.

1.2 SUMMARY

A. The Contractor shall furnish and install, as indicated on the Drawings or specified herein, the following telephone, voice/data and video system equipment and ancillary components:

1. Telephone and data terminal boards
2. Raceways
3. Outlet boxes, pull boxes and junction boxes

B. The telephone utility and other Owner-appointed contractors shall furnish and install the following systems and components:

1. Service entrance cable and connection to the Basic Operating Company system
2. Control and signal media
3. Consoles as required
4. Telephone switch and instruments
5. Modems, drivers, terminals and other related equipment

1.3 SUBMITTALS

A. Submit product data for all telephone and data equipment being provided.

1.4 QUALITY ASSURANCE

A. All telephone and data system equipment and components shall comply with and be installed in accordance with the latest revision of the following codes and standards:

1. NFPA 70 "National Electrical Code"

2. Applicable sections of FCC Part 68 and Part 15

3. IEEE Standard 241, Section 13

4. Applicable standards by RFA and EIA

5. BICSI "Telecommunications Distribution Methods Manual."

B. All telephone system equipment and components shall be installed in accordance with the requirements of the local Basic Operating Company or utility.

PART 2 - PRODUCTS

2.1 TELEPHONE AND DATA SYSTEM

A. Telephone and data terminal boards shall be constructed of 3/4" (19 mm), 4' x 8' (1200 mm x 2400 mm) fire-rated plywood. Terminal boards shall have smooth surfaces and edges and shall be painted with fire-resistant paint. Terminal boards shall be 8' (2400 mm) high and shall have a length as indicated on the Drawings. Terminal boards shall be installed with the bottom edge 6" (150 mm) AFF.

B. Outlet boxes shall be 4 inch square (100 mm), 2-1/8 inches (53 mm) deep with 1/2 inch (13 mm) raised single-gang covers and blank stainless steel cover plates.

C. Devices shall be provided where indicated on the Drawings by the Basic Operating Company or the Owner-appointed telephone contractor.

D. Telephone raceways shall be as indicated on the Drawings and shall comply with the requirements of Division-26 Section, "Raceways". Except as noted otherwise, telephone raceways shall be no smaller than 1 inch (25 mm).

2.2 VOICE/DATA AND VIDEO SYSTEM

A. Computer data outlet boxes shall be 4 inch square (100 mm), 2-1/8 inches (53 mm) deep with 1/2 inch (13 mm) raised single gang covers.

B. Data raceways shall be as indicated on the Drawings and shall comply with the requirements of Division-26 Section, "Raceways". Data raceways shall be no smaller than 1 inch (25 mm).

C. Data raceways in exposed locations shall be rigid steel, raceways in concealed spaces may be EMT.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install telephone and data system equipment and components, where indicated on the Drawings or specified herein, in accordance with manufacturers' written instructions and recognized industry practices.

B. Install a 1 inch (25 mm) empty conduit between each telephone and computer data outlet box and the above-ceiling space or to a height of 9' - 0" (2700 mm - 0 mm) above the finished floor where a removable ceiling is not provided. Provide a 90 degree elbow and bushing on the end of the conduit in the ceiling space. The direction of the elbow shall be adjustable. All empty conduits shall be terminated above accessible ceilings, or extended to backboard when ceilings are not accessible.

C. Install a pull box or junction box after every two (2) 90 degree elbows.

D. Conduit fittings shall not be used. All raceway bends shall be wide-sweep field bends.

E. Conduit terminations at telephone terminal boards shall be extended to 3 inches (75 mm) of the edge of the terminal board and shall be terminated with an insulated bushing.

F. Install a pull wire in each and every empty conduit.

END OF SECTION

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

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. Communications equipment coordination and installation.
2. Sleeves for pathways and cables.
3. Sleeve seals.
4. Grout.
5. Common communications installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of communications equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Metraflex Co.

d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.

3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cable.
3. 50/125 micrometer, optical fiber cabling.
4. Coaxial cable.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Cabling identification products.

B. Related Sections:

1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.

b. Minimum bending radius.

c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration drawings and printouts.

4. Wiring diagrams to show typical wiring schematics including the following:

   a. Cross-connects.

   b. Patch panels.

   c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

   a. Vertical and horizontal offsets and transitions.

   b. Clearances for access above and to side of cable trays.

   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

   d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For splices and connectors to include in maintenance manuals.

G. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.

2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: Three of each type.

2. Connecting Blocks: Three of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.

2. Lacing bars, spools, J-hooks, and D-rings.

3. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Belden CDT Inc.; Electronics Division.

2. Berk-Tek; a Nexans company.

3. CommScope, Inc.

4. Mohawk; a division of Belden CDT.

5. Superior Essex Inc.

6. SYSTIMAX Solutions; a CommScope Inc. brand.

7. 3M.

8. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-B.1 for performance specifications.

3. Comply with TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG, CMP, CMR,

b. Communications, Plenum Rated: Type CMP complying with NFPA 262.

c. Communications, Riser Rated: Type CMR, CMP, complying with UL 1666.

d. Communications, Limited Purpose: Type CMX, CMP, CMR,

e. Multipurpose: Type MP or MPG; or MPP

f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Premise Wiring.

2. Leviton Voice & Data Division.

3. Molex Premise Networks; a division of Molex, Inc.

4. Panduit Corp.

5. Siemon Co. (The).

6. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. 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.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, 4-pair cables in 36-inch (900-mm) lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Berk-Tek; a Nexans company.

2. CommScope, Inc.

3. Corning Cable Systems.

4. General Cable Technologies Corporation.

5. Mohawk; a division of Belden CDT..

6. Superior Essex Inc.

7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Multimode, 50/125 micrometer, 24 -fiber, nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA/EIA-568-B.3 for performance specifications.

3. Retain first option in first subparagraph below for 50/125-micrometer cable; retain second for 62.5/125-micrometer cable.

4. Comply with TIA/EIA-492AAAA-B for detailed specifications.

5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.

b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.

6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.

2. American Technology Systems Industries, Inc.

3. Berk-Tek; a Nexans company.

4. Corning Cable Systems.

5. Dynacom Corporation.

6. Hubbell Premise Wiring.

7. Molex Premise Networks; a division of Molex, Inc.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

A. Comply with the requirements in Division 27 Section "CATV System."

2.8 COAXIAL CABLE HARDWARE

A. Comply with the requirements in Division 27 Section "CATV System."

2.9 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead.

4. Extend conduits 3 inches (76 mm) above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.

2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Where patch panels are not used, coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping. "Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Bond metallic equipment to the grounding grid, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

   1. Administration Class: 1

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section.Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.

D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.

E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.

b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with

measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

   b. Link End-to-End Attenuation Tests:

      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

      2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Multiuser telecommunications outlet assemblies.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Telecommunications outlet/connectors.
6. Cabling system identification products.

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.

D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

F. EMI: Electromagnetic interference.

G. IDC: Insulation displacement connector.

H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

I. LAN: Local area network.

J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

L. RCDD: Registered Communications Distribution Designer.

M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.

N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

O. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.

b. Minimum bending radius.

c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration drawings and printouts.

4. Wiring diagrams to show typical wiring schematics, including the following:

a. Cross-connects.

b. Patch panels.

c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

a. Vertical and horizontal offsets and transitions.

b. Clearances for access above and to side of cable trays.

c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.

D. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance Data: For splices and connectors to include in maintenance manuals.

H. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: Three of each type.

2. Connecting Blocks: Three of each type.

3. Device Plates: Ten of each type.

4. Multiuser Telecommunications Outlet Assemblies: Ten of each type.

PART 2 - PRODUCTS

2.1 UTP CABLE

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Mohawk; a division of Belden CDT.
5. Superior Essex Inc.
6. SYSTIMAX Solutions; a CommScope, Inc. brand.
7. 3M.
8. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, **Category 6** Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70

2.2 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Technology Systems Industries, Inc.
2. Hubbell Premise Wiring.
3. Leviton Voice & Data Division.

4. Molex Premise Networks; a division of Molex, Inc.

5. Nordex/CDT; a subsidiary of Cable Design Technologies.

6. Panduit Corp.

7. Siemon Co. (The).

8. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: **110-style IDC for Category 6**. Provide blocks for the number of cables terminated on the block, plus **25** percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. 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.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: **One** for each four-pair **UTP cable**

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in **48-inch (1200-mm)** lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.3 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

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. Chatsworth Products, Inc.
2. Hubbell Premise Wiring.
3. Molex Premise Networks; a division of Molex, Inc.
4. Nordex/CDT; a subsidiary of Cable Design Technologies.
5. Ortronics, Inc.
6. Panduit Corp.
7. Siemon Co. (The).

B. Description: MUTOAs shall meet the requirements for cable connecting hardware.

1. Number of Terminals per Field: **One** for each conductor in assigned cables.
2. Number of Connectors per Field:
   a. **One** for each four-pair UTP cable indicated.
   b. **One** for each four-pair conductor group of indicated cables, plus **25** percent spare positions.
3. Mounting: Per drawings.
4. NRTL listed as complying with UL 50 and UL 1863.
5. Label shall include maximum length of work area cords, based on TIA/EIA-568-B.1.
6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: **Four** or more (per drawings) port-connector assemblies mounted in **multigang** faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."

2. Metal Faceplate: **Stainless steel**, complying with requirements in Division 26 Section "Wiring Devices."

3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

4. Legend: Machine printed, in the field, using adhesive-tape label.

5. Coordinate faceplate type with the owner.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead.

4. Extend conduits **3 inches (76 mm)** above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. MUTOA shall not be used as a cross-connect point.

5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.

2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than **48 inches** apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable **6 feet (1800 mm)** long not less than **12 inches (300 mm)** in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding to minimize the length of bonding conductors.

D. Bond metallic equipment to the grounding grid, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Administration Class: 4. Coordinate requirements with Owner.

2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 4 level of administration, including optional identification requirements of this standard. Coordinate labeling with the owner.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding systems and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.

    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually confirm Category 6**,** marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

    b. Link End-to-End Attenuation Tests:

        1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

6. UTP Performance Tests:

a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

1) Wire map.

2) Length (physical vs. electrical, and length requirements).

3) Insertion loss.

4) Near-end crosstalk (NEXT) loss.

5) Power sum near-end crosstalk (PSNEXT) loss.

6) Equal-level far-end crosstalk (ELFEXT).

7) Power sum equal-level far-end crosstalk (PSELFEXT).

8) Return loss.

9) Propagation delay.

10) Delay skew.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.

8. Coaxial Cable Tests: Conduct tests according to Division 27 Section "Master Antenna Television System."

9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in

BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 271500

SECTION 28 3111 - FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall provide and install a microprocessor based fire alarm and detection system. The system and components shall be the product of a single manufacturer of established reputation and experience. Installation shall include all parts, labor, software and hardware necessary to affect a complete installation.

B. In addition to the requirements of this section, the electrical and fire alarm contractors shall review the mechanical drawings for quantities and locations of fire alarm devices such as smoke detectors, heat detectors, smoke dampers, etc.

C. The complete set of Architectural, Structural, Civil, Mechanical, and Electrical drawings, specifications, and addenda apply to this work.

1.2 REQUIREMENTS

A. The latest editions of the following codes and standards shall govern work performed under this section:

1. NFPA 101 - Life Safety Code
2. International Building Code (IBC)
3. International Fire Code (IFC)
4. NFPA 70 - National Electrical Code
5. NFPA 72 - National Fire Alarm Code
6. NFPA 80 - Fire Doors and Windows
7. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
8. NFPA 13 - Standard for installation of sprinklers
9. Americans with Disabilities Act (ADA)

1.3 RELATED SECTIONS

A. Division-08 Section - Door Hardware: Door closers, electric locks, electric releases.

B. Division-21 Section - Fire Protection.

C. Division-23 Section - Ductwork Accessories: Smoke dampers.

D. Division-26 Section - Raceways.

E. Division-26 Section - Wires and Cables.

F. Division-26 Section – Boxes, Fittings and Cabinets.

1.4 SYSTEM DESCRIPTION

A. The combination fire alarm and carbon monoxide detection system shall be a microprocessor based, power-limited, supervised, 24 VDC, non-coded system. An event history log of up to 500 alarm and trouble events shall be continuously maintained in non-volatile memory at the control unit. (The actual number of individual alarm and trouble events may be less than 500, provided the total combined number of alarms and troubles logged is at least 500.) The system shall be capable of providing the following functions:

1. Integral clock/calendar.

2. Alarm verification (assigned by detector address).

3. System shall comply with National Standard Evacuation Signal Temporal Code 3.

4. A carbon monoxide event will cause a Signal Temporal Code 4. Coordinate exact requirements with Fire Marshal.

5. Functional walk-test of all initiating and signaling devices.

6. Indicate all alarm and trouble events at a remote fire alarm annunciator (textual visual appliance) and record same using an printer.

7. Firefighters telephone.

8. Fire pump monitoring and control.

9. HVAC monitoring and control.

10. Security system monitoring and control.

11. Standby generator system monitoring and control.

12. Drill switch.

B. Initiating Devices:

1. Provide manual stations within five feet (1500 mm) of each exit along the normal path of egress travel, along the egress path as required to ensure that travel distance to any manual station does not exceed 200 feet (60 m), and where required by NFPA 72.

2. Provide analog duct smoke detectors, sampling tube, housing and mounting equipment and connect to system to initiate supervisory signal and shutdown respective air handlers as required by NFPA 90A.

3. Supply interface monitor modules for automatic sprinkler system waterflow switches and connect to the system to initiate alarm signal.

4. Supply interface monitor modules for automatic sprinkler system valve tamper switches and pressure switches and connect to system to initiate supervisory signal.

5. Supply interface monitor modules for fire pump alarms. Provide a separate module for each alarm: pump running, loss of power in any phase and phase reversal.

6. Provide addressable CO detectors with sounder bases and connect to system to initiate supervisory signal.

C. Notification Appliances:

1. Provide combination horn/strobe signals throughout as required to ensure audibility and intelligibility of signal as detailed in NFPA 72.

2. Provide additional non-textual visual appliances throughout building to ensure all signals are visible to all occupants as required by the ADA.

D. Auxiliary Functions:

1. HVAC Shutdown - Shut down respective air handler upon activation of associated duct smoke detector(s).

2. Smoke Dampers - Close respective smoke damper upon activation of associated duct smoke detector(s).

1.5 QUALITY ASSURANCE

A. The system and all components shall be listed by Underwriters Laboratory for fire protective signaling service (local and remote station, emergency communication and relocation equipment, protective signaling systems) under UL 864. Automatic detectors, manual stations, sprinkler system alarm attachments, control unit accessories, indicating appliances and all other alarm system attachments shall be listed, labeled and approved for use with the specified control equipment. Visual indicating appliances shall be listed and labeled under UL 1971, "Signaling Devices for the Hearing Impaired".

1. Equipment Not Described: The Drawings and Specifications are schematic only and are not intended to relieve the Contractor from responsibility for furnishing all material, equipment and labor required to affect proper system operation. System subassemblies, software, programming, hardware, interface devices, controls, tools, test equipment and related devices vary considerably among manufacturers and cannot be fully described without reducing competition.

2. Manufacturer/Distributor Support: The Contractor shall confirm to the satisfaction of the Owner that a factory authorized support organization exists within close proximity to the site. Such organization shall be adequately stocked with equipment, parts and accessories, and adequately trained and capable to perform all required engineering, maintenance and testing support necessary to ensure continued efficient and effective system operation.

1.6 SUBMITTALS

A. Shop drawing and product data approval shall be obtained from the Engineer and Fire Marshall prior to commencing system installation. Submit shop drawings and product data as required for review and approval. Following substantial completion, operations and maintenance data and record drawings shall be submitted to the Owner.

1. Shop drawings shall include a building floor plan indicating the location of all zones, system devices and components, a wiring riser diagram, panel wiring diagram, device wiring details, listing of device addresses, sequence of operation and battery calculations. Drawings shall clearly indicate the height and location of all equipment, devices, wiring, conduit and junction boxes. Drawings shall be clean, neat, professionally prepared by CADD or manual drafting.

2. Statement of Compliance and Deviation:

    a. The submittal package shall include a copy of these specifications with each sub-paragraph noted with the comment "Compliance", "deviation", or "alternate".

    b. By noting the term "compliance", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.

    c. By noting the term "deviation", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.

    d. By noting the term "alternate", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. Any alternate shall be fully described as to what the manufacturer proposes to provide.

3. Installation Instructions: Manufacturer's installation guide and programming instructions shall be submitted with the shop drawings.

4. Operations and Maintenance Data: Manufacturer's operating instruction and maintenance manuals, installation instructions and programming guides shall be supplied to Owner and his representatives within fifteen (15) days of substantial completion. Five (5) copies of each manual shall be provided.

5. Installer's UL Certificate: Provide a copy of the UL certificate or equivalent evidence that the fire alarm contractor is listed by UL or a NRTL for installation and maintenance of "Protective Signaling Systems."

6. Record Drawings: All deviations from the approved shop drawings require prior approval of the Engineer. Within fifteen (15) days of substantial completion, record drawings indicating the location and

configuration of all equipment, devices, wiring, conduit and junction boxes shall be supplied to the owner. Five (5) copies of each drawing shall be provided. Drawings shall be clean, neat, professionally prepared by CADD or manual drafting.

7. Computer (CADD) files of electrical drawings will not be made available to the Contractor for any purposes.

1.7 SPARE PARTS

A. Contractor shall supply the Owner with a minimum of one (1) replacement for each six (6) devices (or fraction thereof) installed of the following devices:

1. Analog Smoke Detectors
2. Manual Stations
3. Interface Monitor Modules
4. Interface Control Modules
5. Strobe Signals
6. Strobe Signals
7. Duct Smoke Detector
8. Heat Detectors
9. Horn/Strobe Signals
10. Telephone Handsets
11. CO Detectors with sounder bases

1.8 PROGRAMMING AND TEST DEVICES OR TOOLS

A. Contractor shall furnish all devices necessary to conduct tests of all devices and equipment prior to substantial completion. Upon satisfactory completion of required tests, the contractor shall furnish the owner with two of each device, tool or accessory used and required to perform complete periodic tests and maintenance. Such devices or tools may include interface devices, interface module programming tools, keys, program codes, software and the like. These devices, tools and

accessories shall become the property of the Owner.

PART 2 - PRODUCTS

2.1 CONTROL PANEL

A. The control panel shall provide power, supervision, annunciation and control of all detection and alarm devices. All external circuits shall be inherently power-limited as described in NFPA 70 Article 760. The control panel shall be of modular construction to permit expansion and modification of system functions. All modules and controls required to provide reliable operation as described in the Drawings and Specifications shall be provided. The status and sensitivity of analog devices shall be capable of being read, displayed and adjusted at the control panel. The system shall be capable of responding to alarm conditions while in the maintenance, program and test modes. Program or maintenance activities which bypass or disable system devices or functions shall be continuously monitored, displayed and recorded in the event history log. When devices or functions are disabled or bypassed, a trouble or supervisory condition shall exist until the function is restored to "normal". Addressable devices and addressable interface modules (monitor and control) shall be individually identified by the control unit. Conventional devices shall be capable of being supported by addressable interface modules.

B. Textual annunciation shall be provided at the control unit and remotely as indicated on the Drawings. The textual display shall consist of an 80 character alphanumeric display, which shall include a 32 character user defined message for each device or function. Each of the following functions shall be continuously monitored: analog detector sensitivity, response, open circuits, short-circuit faults, ground faults (+/-), functionality and test. The annunciator shall be capable of displaying the status of each detector and occurrence of each state. All events displayed on the textual display shall also be recorded on an integral, 40-column, thermal strip printer. Annunciator controls at each location shall include momentary contact switches for locate, next alarm, next trouble, display hold, acknowledge, signal silence, trouble silence and system reset. Equivalent switch configurations providing the same functions are acceptable. LEDs shall be provided at each annunciation location to indicate system power (green), trouble (yellow), supervisory alarm (yellow), alarm (red). The connection between the remote annunciation and the system control panel shall be electrically supervised.

C. All wiring shall be continuously supervised for proper operation. There shall

be no unsupervised wiring except for short connections, not to exceed 10 feet (3 m) in length, to motor starters and controls. Abnormal conditions shall be reported at the control unit and remote annunciator within 90 seconds of occurrence.

D. The removal or disabling of any initiating or notification appliance shall produce a trouble signal. Replacement of any analog initiating device with another device of another type, even with the same address, shall initiate a trouble signal.

E. Primary power shall consist of a two-wire 120 VAC branch circuit as indicated on the Drawings. The branch circuit disconnect shall be arranged and protected to prevent inadvertent disconnection and ensure optimum reliability.

F. Secondary supply batteries shall be capable of powering the system under maximum normal load for twenty-four (24) hours followed by five (5) minutes of evacuation alarm operation at maximum connected load in accordance with NFPA 72 requirements for emergency alarm communications service. In the alarm mode, the system shall be capable of powering all devices including horns, strobe lights, detectors and auxiliary devices. All circuit wiring (AC or DC) shall be separately fused within the control panel.

G. In the control mode, the system operator shall have the ability to arm or disarm system devices and control functions individually (by address) and manually operate devices. Analog detector sensitivity shall also be adjustable in the control mode. Access to the control mode shall be restricted by security passwords.

H. The system shall permit functional tests of all initiating and indicating appliances by a single individual remote from the control panel. The system shall maintain a log of this activity on a dedicated printer and retain a record in the event history log of the last 500 events. Provide a 24-pin "dot-matrix" printer. Provide portable stand for printer with paper storage space. Stand shall be approximately 3 feet high. Coordinate dimensions of stand with printer.

I. A drill switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, all alarm functions would occur as described previously.

J. Activation of any alarm initiating device shall automatically operate all audible and visual appliances and produce an alarm signal at the control unit and at the remote annunciators. Subsequent alarm events shall be continuously stored in the event history log. Alarm signals shall have

priority over all other system signals. All alarm signals shall be automatically transmitted to the central station.

K. Activation of an analog duct detector, sprinkler valve tamper switch, pressure switch, door hold-open smoke detector, standpipe flow switch, or fire pump alarm shall initiate supervisory alarms at the system control panel and at the remote annunciators. Supervisory audible and visible alarms at these locations shall be distinct from either alarm or trouble conditions involving the same or related devices. All supervisory alarms shall be transmitted to the central station.

L. Open circuits, ground faults, missing detectors, abnormal detector status (e.g.: dirty detector, replacement incompatible with definition), disabled devices, low battery voltage and abnormal control functions shall initiate audible and visible trouble signals at the control unit and remote annunciators. Audible trouble signals shall sound until silenced. Silenced trouble signals shall be continuously indicated by a textual message and a trouble LED until restored to normal operation. The trouble LED shall remain illuminated until all abnormal conditions are cleared. Upon a return to normal operation the audible trouble signal shall resound until restored to normal position. Subsequent trouble events shall resound audible trouble signals until silenced. All trouble events shall automatically be transmitted to the central station.

M. Access to control unit and remote annunciator switches, wiring and power supplies shall be restricted by keyed-alike locks. Control function and programming access shall be limited by user defined passwords.

2.2 ALARM INITIATING DEVICES

A. Alarm initiating devices shall consist of addressable detectors and manual stations. These devices shall be listed and approved for use with the control equipment specified.

1. Analog smoke detectors shall be addressable, ionization (or photoelectric where indicated on the Drawings), plug-in type with base. The detector base shall be of the twist/lock type with screw terminals for field wiring. An automatic gain control circuit shall be provided to compensate for detector aging and dirt accumulation and maintain the detector within the correct sensitivity range. A critical reduction of sensitivity caused by dirt accumulation shall initiate a trouble signal. Detector sensitivity shall be capable of being read and adjusted from the control panel.

2. Interface monitor modules shall be addressable, mounted in

standard 4" x 4" (100 mm x 100 mm) square or octagonal electrical boxes with covers. Cover shall be labeled or embossed with fire alarm system interface module designation. A solid state LED indicator lamp shall be visible in the cover. These modules are to be used for connection of conventional alarm devices such as waterflow switches, valve tamper switches, sprinkler pressure switch, fire pump alarms and other non-addressable devices. Connections between devices and modules shall be integrally supervised for open and ground faults. Monitor and control functions may be integrated in a single interface module if listed and approved for this purpose.

3. Duct type detector assemblies shall consist of an addressable analog photoelectric detector, an air duct sampling tube and detector housing. Provide a remote test station with alarm indicating lamp for all duct detectors installed in concealed spaces.

4. Manual stations shall be addressable, red in color, non-coded, double-action, non-break glass type. Manual station covers shall be hinged and secured with a lockset. Lockset shall be keyed the same as the control unit lockset.

5. Heat detectors shall be addressable, plug-in type with base. The detector base shall be of the twist lock type with screw terminals for field wiring. Detectors shall be rate-compensation, fixed temperature type, rated at 135 °F (57°C). Detector element shall be self-restoring after operation.

6. CO detectors shall be addressable, plug-in type with sounder base to provide localized Temporal 4 pattern for CO alarm indication. The Detectors shall meet UL 2075 Standard for system-connected, life safety carbon monoxide detection.

B. Contractor shall include [3] combination CO/smoke detectors, [5] heat detectors and [2] pull stations inclusive of associated labor (including circuit ring-out and programming) and material to install after final walk-through by Fire Marshal. Devices shall be installed in locations as directed by Fire Marshal and shall include all cutting, patching and finishing of walls. All unused devices shall be turned over to the Owner for use as spares.

2.3 NOTIFICATION APPLIANCES

A. Alarm indicating appliances for areas where alarm is required shall consist of audible and visual signals for public signaling of fire. The primary

signaling scheme shall consist of horn/strobes transmitting a tone.

1. Horn/strobes shall have semi-flush mounted with red covers and clear strobe lens. Horn/strobe signals shall comply with the requirements of the ADA and NFPA 72, Chapter 6.

2. Strobe units shall consist of a red cover and clear lens. Strobe signals shall comply with the requirements of the ADA and NFPA, Chapter 6.

B. Strobes shall provide a minimum effective intensity of candela levels listed on the contract drawings. Strobes in hotel guest rooms and similar occupancies shall provide a minimum effective intensity of 110 candela. Strobes shall be listed to 1971 Standard Underwriter Laboratories.

C. Alarm indicating appliances to be installed on the exterior of the building shall be weatherproof and listed for outdoor use.

D. Contractor shall include [5] audible [5] visual and [3] combination audible/visual devices inclusive of associated labor (including circuit ring-out and programming) and material to install after final walk-through by Fire Marshal. Devices shall be installed in locations as directed by Fire Marshal and shall include all cutting, patching and finishing of walls. All unused devices shall be turned over to the owner for use as spares.

2.4 AUXILIARY DEVICES

A. Magnetic door holders shall be used to hold fire or smoke doors in the open position during normal operation. Upon activation of smoke detectors located immediately adjacent to the door opening, the door holders release, allowing the doors to close automatically. Detectors initiating this function shall be located and installed in accordance with NFPA 80. Door holders shall be listed and approved for the intended use, and connected to the control panel by an addressable interface module (control).

B. Interface control modules shall be addressable, mounted in standard 4" x 4" (100 mm x 100 mm) square or octagonal electrical boxes with covers. Cover shall be labeled or embossed with fire alarm system interface module designation. A solid state LED indicator lamp shall be visible in the cover. These modules are used for control of auxiliary functions such as fan shutdown, sprinkler system electric water gong, and door holder release. Interface modules shall be equipped with form "C" dry-contacts rated 2A, 125 VAC or 2A, 30 VDC resistive. Monitor and control functions may be integrated in a single interface module if listed and approved for

this purpose.

2.5 FIREFIGHTERS TELEPHONE

A. A two-way firefighters telephone system shall be provided. A hardwired handset and six portable handsets shall be provided at the central command center with the main fire alarm control panel.

B. Handsets shall be red, high-impact plastic with retractable coil cord. Portable handsets shall have push-to-talk button and a phone-type plug.

C. Remote firefighters telephone jacks shall be fully compatible with the firefighters telephone system and shall be located where indicated on the Drawings. The jacks shall be mounted on a baked enamel-finished steel single gang wall plate engraved with a telephone handset icon and the words "FIREMAN'S TELEPHONE" or other suitable description. The phone jacks shall include a surge suppressor and the circuitry necessary to initiate a zone call-in signal at the command console when a handset is plugged into the jack.

2.6 GRAPHIC ANNUNCIATOR PANELS

A. Graphic annunciator panels shall be minimum 24" x 30" (600 mm x 750 mm), with white photo-emulsion graphics in smoked plexiglass and LCD display. The panel shall include an outline of each zone and shall utilize backlit displays to indicate alarm types and locations.

B. The fire alarm control panel or annunciator panels shall include, but in no way be limited to, the following alarms, controls and status indicators:

1. Alarm, trouble and power-on for system.

2. Alarm type and location for each zone.

3. Trouble for each zone.

4. Run and trouble indicators for standby generator.

5. Run, trouble, phase reversal indicators for fire pump.

6. Auto/run switch for fire pump.

7. Run/auto/off switches for smoke exhaust fan.

8. Run/auto/off switch for smoke exhaust system for each zone.

9. On indicators for smoke exhaust fan, general exhaust fan, and smoke exhaust system whether activated automatically or manually.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division-26 Section, Basic Electrical Materials and Methods for general execution requirements.

B. Smoke detectors shown on the Drawings indicate areas where smoke detectors shall be installed. The location and quantity of smoke detectors shall be in accordance with NFPA 72 and the UL Listing for the specific devices.

C. Heat detectors shown on the Drawings indicate areas where heat detectors shall be installed. The location and quantity of heat detectors shall be in accordance with NFPA 72 and the UL Listing for the specific devices.

D. Duct smoke detectors shall be installed in accordance with manufacturer's written instructions. Detectors shall be readily accessible for cleaning and testing. Provide access panels or doors if necessary. Provide duct detectors on both the supply and return of all air handling units provided under this contract unless otherwise noted.

E. Interface modules (monitor and control) shall be located within 3 feet (75 mm) of the device it is monitoring or controlling.

F. Strobes shall be installed with the bottom of the appliance 80 inches (2000 mm) above the finished floor or 6 inches (150 mm) below the finished ceiling, whichever is lower.

G. Manual stations shall be installed with the top of the device 48 inches (1200 mm) above the finished floor.

H. Coordinate connection of smoke dampers with mechanical contractor. Make special efforts to communicate and review fire alarm system voltage (24V) with mechanical contractor for smoke damper voltage.

I. Coordinate connection to 24 volt sprinkler system electric motor gong with sprinkler system contractor to ensure gong is only operated upon sprinkler pressure switch sensing a fluctuation in water pressure. Sprinkler

electric water gong shall be powered from the fire alarm system by a fully supervised circuit. Provide power supervisory relay and monitoring module as required to provide this supervision.

J. Provide supervision of electrical circuits serving heat tracing used on sprinkler piping per NFPA 13, section 8.16.4.1.4.2. Provide positive confirmation that circuit is energized. Provide supervisory signal at FACP upon loss of power to heat trace system.

K. Carbon monoxide detectors shall be addressable, UL 2075 listed, plug-in type with base. The detector base shall be of the twist/lock type with screw terminals for field wiring. An automatic gain control circuit shall be provided to compensate for detector aging and dirt accumulation and maintain the detector within the correct sensitivity range. A critical reduction of sensitivity caused by dirt accumulation shall initiate a trouble signal. Detector sensitivity shall be capable of being read and adjusted from the control panel.

L. Combination smoke and carbon monoxide detectors shall be addressable, UL 268 & 2075 listed, plug-in type with base. The detector base shall be of the twist/lock type with screw terminals for field wiring. An automatic gain control circuit shall be provided to compensate for detector aging and dirt accumulation and maintain the detector within the correct sensitivity range. A critical reduction of sensitivity caused by dirt accumulation shall initiate a trouble signal. Detector sensitivity shall be capable of being read and adjusted from the control panel. The detector shall have separate detection signals for carbon monoxide and smoke. The detector shall use only one address on the SLC.

3.2 QUALIFICATIONS

A. System installation shall be supervised by an experienced fire alarm technician with not less than five (5) years' experience with fire alarm systems. All field installation work shall be continuously supervised by a NICET Level II or III fire alarm system technician.

B. Fire alarm system shall be installed and maintained by a listed fire alarm contractor, listed by UL for installation and maintenance of "Protective Signaling Systems" or other NRTL. The fire alarm contractor shall meet all UL requirements and provide a copy of the UL certificate to the Fire Marshal.

C. The Contractor installing the fire alarm system shall provide a copy of the UL certification or FM placard to the Baltimore County Fire Marshal's Office for the newly installed system.

3.3 CHANGES

A. The technician supervising field work shall promptly notify the engineer of any changes or deviations from the contract drawings and specifications necessitated by field conditions.

3.4 WIRING

A. All field wiring shall be installed in conduit. Conduit and boxes shall be sized according to National Electrical Code requirements based on the number of conductors. Initiating device circuit wiring shall be two-conductor twisted with integral shield and ground. Indicating appliance circuits shall be minimum 14 AWG. Primary power (AC) branch circuit conductors shall be minimum 12 AWG. Address loop circuits shall be a minimum of 18 AWG.

B. Fire alarm circuits shall be identified by red junction box covers stenciled in white letters "FIRE ALARM."

C. Fire alarm wiring shall be color coded in accordance with requirements of local Authority Having Jurisdiction.

D. The addressable loop shall be wired Class B, Style 4. The initiating devices shall be wired Class B, Style B. The notification appliances shall be wired Class B, Style Y. Where transponder panels are required, wiring from control panel through the transponder panels shall be Class A, Style 6.

E. All wiring shall be tested for the following conditions before devices are installed or circuits connected to control equipment:

1. Verify that stray (unwanted) voltages do not exist between the installation conductors and ground or between conductors.

2. Verify all conductors not intentionally grounded are isolated from ground using an approved insulation testing device or "megger."

3. Verify that all conductors not intentionally connected together are isolated from one another using an approved insulation testing device or "megger."

4. Measure and record the loop resistance of each circuit with the conductor pair shorted together at the far end, verify that loop resistance does not exceed manufacturer's requirements.

F. Supply the Owner and Engineer with a copy of all circuit testing reports

and loop resistance readings.

3.5 SYSTEM TESTING

A. All initiating and indicating appliances, control equipment, accessories and auxiliary functions shall be tested in accordance with NFPA 72 acceptance test procedures. Representatives of the Owner, Engineer and local Fire Marshal shall be notified of the date and time of the test. A minimum of fourteen (14) days' notice is required when scheduling the acceptance test. The Contractor is responsible for conducting all required tests. All necessary equipment and supplies shall be provided at Contractor's expense, including ladders, radios, test equipment, volt-ohm meter, sound-pressure (decibel) meter, flashlights, hand tools and smoke or smoke substitute for functional tests. All test procedures shall conform to the manufacturer's recommended test procedures and the NFPA 72 recommended practice. Subcontractors responsible for related work connected to or controlled by the fire detection and alarm system shall be available to demonstrate their equipment at the time of acceptance testing.

B. Testing of indicating appliances shall be scheduled in accordance with Owner requirements.

3.6 TEST REPORT

A. The Contractor shall prepare and submit a test report in the form and content required by NFPA 72. The report shall be signed by the supervising technician or fire protection engineer. The Contractor shall submit the report to the Owner and his representatives, upon completion of testing.

3.7 WARRANTY

A. The completed system shall be warranted for a period of two (2) years from the date of acceptance. The warranty shall cover all defects in parts and workmanship, and expenses related to parts, labor and travel to and from the site for the purposes of correcting same. Maintenance and repair shall be performed only by a factory trained service technician.

3.8 TRAINING

A. Contractor shall arrange and furnish training for Owner's representatives. This training shall include instruction in proper system maintenance, test

and troubleshooting procedures. Provide a minimum of eight (8) hours of training.

3.9 PROJECT CLOSEOUT

A. See Section 260200, "Project Closeout – Electrical", for more requirements.

END OF SECTION

SECTION 31 2200 - SITE EXCAVATION AND EARTHWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Clearing and Grubbing

B. Pavement Removal

C. Stripping and Stockpiling Topsoil

D. Excavation

E. Subgrade Preparation

F. Filling

G. Backfilling

H. Rough Grading

I. Tests and Inspections

1.2 RELATED SECTIONS

A. Section 31 2220 - Earthwork for Utilities

B. Section 31 2270 - Erosion and Sediment Control

C. Section 31 2923 - Landscape Grading

D. Section 31 2930 - Seeding

E. Section 31 2950 - Trees, Plants and Ground Cover

F. Section 32 2575 - Paving and Resurfacing

1.3 REFERENCES

A. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))

C. ASTM D1556 - Density of Soil in Place by the Sand Cone Method.

D. ASTM D1557 - Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 Pound Rammer and 18-inch Drop.

E. ASTM D2167 - Density of Soil in Place by the Rubber Balloon Method.

F. ASTM D2487 - Classification of Soils for Engineering Purposes.

G. ASTM D2922 - Density of Soil and Soil Aggregate in place by Nuclear Methods.

H. ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

I. NFPA 495 - Manufacture, Transportation and Storage and Use of Explosives.

J. AASHTO - M14 - Materials for Aggregate and Soil Aggregate.

1.4 QUALITY ASSURANCE

A. All filling, backfilling and subgrade will be laboratory and field tested to verify compaction requirements and conformance with specifications. Testing will be done in accordance with Section 01 4000 - Quality Requirements.

1.5 REGULATORY REQUIREMENTS

A. Conform to local code requirements for disposal of debris.

B. Rules and regulations of the various utility companies and other authorities having jurisdiction over such Work shall be observed in the performance of all earthwork operations.

1.6 EXAMINATION

A. Verify site conditions prior to starting work.

B. Verify that intended elevations for the work are as indicated.

C. Verify all underground and above ground utility line locations, pipes and other infrastructure whether or not these items are included within the categories incorporated in the PA Underground Utilities Act 187 or any amendments thereto.

1.7 PROTECTION

A. Do not damage or disturb any existing monuments, bench marks, structures, fences, sidewalks, paving, curbs and other markers outside the area being graded. Provide suitable protection where required before starting Work. Restore any damage to original condition or repair as directed at CONTRACTOR cost.

B. Before starting Work, protect any trees or shrubs shown or designated to be saved by boxing or wire fencing staked securely in place or by other approved means. Protection shall be maintained until completion of work, or until removal is directed by the OWNER and the ENGINEER.

C. Protect and maintain above and below grade utilities that are to remain.

D. Protect excavations and adjacent property and structures by shoring, bracing, sheet piling, underpinning or other methods as required to prevent cave-in, damage, and/or loose soil from falling into the excavation at no additional cost to the OWNER.

E. The OWNER and ENGINEER shall be notified immediately if any unexpected subsurface condition, such as buried structures or utility lines are encountered, and discontinue work in that area until notified to proceed. The ENGINEER will determine the disposition of the obstruction. The Contractor shall adequately protect and support the obstruction until a determination is made and relocate, realign or dispose of the obstruction as directed by the ENGINEER at no additional cost to the OWNER.

F. Protect the bottom of excavations and soil adjacent to and beneath foundations from frost.

G. The top of the excavation shall be mounded or graded to prevent surface water runoff from entering the excavation.

H. Erect and maintain guide rails, fences, warning lights or other protection as required for the safety of all persons at or adjacent to the excavation.

1.8 SUBMITTALS

A. As-built record drawings shall be submitted in accordance with Section 01 7700 – Closeout Procedures. Record drawings shall accurately locate both new and existing utilities. Utilities shall be located both horizontally from some permanent structure and vertically by elevation.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Any excavated material, graded free of roots, rocks larger than 1 inch, subsoil, debris, weeds and foreign matter. This material is to be stockpiled and for use as directed in Section 31 2923 - Landscape Grading.

2.2 SUITABLE MATERIAL

A. Materials including inorganic soils classified as CL, ML, SM, SC, SW, SP, GW, GP, GM and GC, or a combination of these group symbols, per ASTM D 2487. The materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest dimension. Open graded materials, such as Gravels (GW and GP), which contain void space in their mass should not be used in unless properly encapsulated with filter fabric. Suitable Material should have the following index properties (LL: 40 max, PI 20 max). This material can be used for backfilling and compaction at the site and Utility Trenches under grass areas outside rights-of-ways.

2.3 CLEAN UNSUITABLE MATERIAL

A. Materials including organic materials (OH, OL), elastic Silt (MH), high plasticity Clay (CH), and other excavated natural materials which do not satisfy the requirements for suitable materials and topsoil. This material can be deposited and compacted at the soil stockpile location.

2.4 CONSTRUCTION DEBRIS AND UNSUITABLE MATERIALS

A. All remaining materials that is unsuitable including concrete, masonry, asphalt pavement, and any buried debris encountered, shall become the property of the Contractor for his disposal at an approved disposal site.

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING (IF REQUIRED)

A. Clear and grub all areas required for access to the site and execution of the Work. Remove all trees and shrubs within the marked areas designated for removal.

B. Protect all trees and shrubs designated to be maintained or relocated.

C. Grub out all stumps and roots to a minimum of three feet below finished grade. Clear undergrowth and dead wood without disturbing the subsoil.

D. Remove and dispose of all perishable and objectionable material including but not limited to trees, brush, vines, shrubs, bushes, logs, stumps, roots, weeds, rubbish and other organic material.

E. Trees in rights-of-way shall not be cut down except by authorization of the ENGINEER and/or Township. Excavation by hand, or tunneling may be required in vicinity of trees left standing.

3.2 PAVEMENT REMOVAL (IF REQUIRED)

A. Remove all pavement, road surfaces, curbing, driveways and sidewalks within the lines of excavation. Saw cut areas to be removed, to provide a clean cut in the pavement.

B. Cement concrete pavements shall be opened by sawing. Asphaltic concrete pavements shall be cut to neat straight lines with channeling machines or other methods to provide a clean cut in the pavement and base without undue shattering.

C. All debris and material resulting from the removal shall be removed from the site and legally disposed of by the CONTRACTOR.

D. The use of weights dropped on pavement for breaking will not be allowed except by written approval of the ENGINEER or the Township.

3.3 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Identify all utilities and mark locations.

C. Maintain and protect existing utilities which pass through the work area and are to remain in service.

D. Notify utility companies to remove and/or relocate utilities as required.

E. Upon discovery of unknown utilities or concealed conditions, discontinue Work in the affected area and notify the ENGINEER.

F. Implement all procedures as required by the sediment and erosion control plan. Temporary seeding shall be employed on all areas that are disturbed and remain exposed longer than allowed by the Erosion and Sediment Control permit requirements.

3.4 STRIPPING TOPSOIL

A. Before starting excavation, remove topsoil to its full depth, from all areas that are to be further excavated, re-landscaped or regraded. Do not excavate saturated topsoil.

B. Topsoil shall be stockpiled at the site as directed for use in further finish grading. All stockpiles shall receive temporary seeding.

3.5 STOCKPILING

A. Stockpile materials on site at suitable locations, or as directed by the ENGINEER.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

E. Clean stockpile area of excess fill material. Leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

3.6 EXCAVATION (UNCLASSIFIED)

A. The CONTRACTOR shall perform all excavation required to construct all facilities, structures and Work incidental thereto. Excavation shall extend a sufficient distance to allow working space and inspection, except where concrete is to be deposited directly against excavated surfaces.

B. All loose material shall be removed from excavations, and bottoms shall be carefully leveled to subgrade.

C. None of the above provisions shall be construed to relieve the CONTRACTOR of his responsibility to make a careful personal examination of the site in order to satisfy himself as to the nature and location of the Work required, the conformation of the ground, the soil and rock conditions and the character, quality, and quantity of the materials.

D. Excavated materials shall be inspected by the OWNER'S Soils Testing Contractor and classified for determining the location of disposal.

E. Do not excavate to full depth when rain or freezing conditions are imminent. Where soil surfaces are damaged by water, mud, or otherwise disturbed, all loose mud or other materials shall be removed and the surface regraded.

F. If suitable material, as determined by the OWNER'S Soils Testing Contractor, is not encountered at the depth indicated on the Drawings, the CONTRACTOR shall be directed by the Engineer to excavate further until such time as suitable material is uncovered.

G. The CONTRACTOR shall pump or otherwise remove any water which may be found in the excavation, and he shall provide drainage ditches, underdrains, flumes, well points, pumping equipment or other materials as necessary to keep the excavation free of water so that all required Work can be done in the dry. Except where the dewatering of the Work is specifically paid by unit price, this task shall be considered part of the prices bid and the CONTRACTOR will not receive additional compensation for dewatering.

H. The CONTRACTOR shall shore, brace, and use sheet piling as necessary to prevent caving in accordance with Federal and State laws and codes. Cover holes and trenches when work is not in progress. Fence or barricade sharp changes in plane of more than 3 feet in height. Protect persons from injury and property from damage. The CONTRACTOR shall satisfactorily repair or remove and replace work that has been damaged due to failure to provide adequate support or through negligence or fault of the CONTRACTOR in any other manner. The CONTRACTOR shall remove shoring, sheet piling and temporary items as work progresses, and shall not leave temporary wood in concrete, masonry, or earth fill.

I. Rock excavation is included in unclassified excavation.

3.7 SUBGRADE PREPARATION

A. After excavating and/or stripping topsoil in the areas of buildings, roads and other structures, the existing subgrade shall be proofrolled with at least ten complete coverages of a 10 ton capacity roller, to obtain a firm unyielding subgrade. The CONTRACTOR shall notify the ENGINEER at least seventy-two hours in advance of the proofrolling operation, so that the OWNER'S Soils Testing Contractor can observe the process.

B. If during the proofrolling operations any soft, unstable or yielding areas are found, they shall be overexcavated to a depth and width as ordered by the ENGINEER and backfilled with Suitable Fill compacted to an in-place density of ninety-five percent of the maximum dry density or otherwise stabilized or modified as directed by the ENGINEER.

3.8 FILLING, BACKFILLING AND ROUGH GRADING

A. Filling and backfilling shall be performed to the rough grades and compaction percentages as indicated in the schedule below by placing and compacting select fill or approved common fill in continuous layers not exceeding 8 inches loose depth.

B. The fill or backfill material shall be maintained at -1 and +3% of the optimum moisture content, as determined by laboratory testing, to insure proper compaction.

C. Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

D. At the end of each work day, all fill areas should be graded to facilitate drainage of any precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water.

E. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

F. Horizontally bench existing slopes greater than 1 to 4, to key placed fill material to slope to provide firm bearing.

G. Retaining walls shall be completely cured and braced prior to backfilling.

3.9 BACKFILL SCHEDULE

A. The paragraphs below identify location, fill material to be used in layers from the prepared existing subgrade up to the proposed rough grade or base elevation and compaction as a percentage of the maximum density as determined by laboratory testing.

B. Compaction Equipment

1. Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials.

2. Sheepsfoot compaction equipment should be suitable for the fine-grained soils (Clays and Silts).

3. Vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) as well as for sealing compacted surfaces.

C. Fill Compaction Control

1. The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement.

2. Grade controls should be maintained throughout the filling operations.

3. All filling operations shall be observed on a full-time basis by the OWNER'S Soils Testing Contractor to determine that the minimum compaction requirements are being achieved. Field density testing of fills will be performed at the locations and frequencies shown below, but not less than 1 test per 8" lift.

   a. Building Limits: 1 test per 2,500 sq. ft. per 8" lift
   b. Pavement Areas: 1 test per 10,000 sq. ft. per 8" lift

4. If tests indicate Work does not meet the specified requirements, it shall be removed, replaced and retested until compliance is achieved at no additional cost to the OWNER.

D. Schedule

1. Building and Pavement Areas - Suitable Fill within the building and paving limits should be placed in maximum 8-inch loose lifts, moisture conditioned as necessary to within -1 and +3 % of the soil's optimum moisture content, and be compacted with suitable equipment to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D698).

2. Grassed Areas - Suitable Fill to six (6) inches below finished grade compacted to 95%.

3. Landscaped Areas – Suitable Fill to twenty-four (24) inches below finished grade compacted to 95%.

E. All areas disturbed during construction shall be rough graded to the elevations as indicated on the Drawings (+2 inches). Slope grade away from the building pad a minimum of 2 inches in 10 feet unless noted otherwise on the Drawings. Changes in grade shall be gradual and slopes shall be blended into level areas.

F. Clean stockpile areas of excess fill material and remove surplus from the Cumru Township Municipal Campus Site. Any paved area (new or existing) over which hauling operations or other equipment moving is or was conducted shall be kept clean and any soil or other material left on paved surfaces shall be promptly removed by the CONTRACTOR.

G. Any areas damaged or disturbed during the course of the Work shall be restored to their original condition as directed by the ENGINEER.

3.10 SEQUENCE

A. Site Preparation:

1. All trees and brush, including large roots shall be cleared and removed from the portion of the site on which improvements are to be made that has not already been cleared. All topsoil in newly proposed paved areas and building sites shall be stripped and stockpiled for non-suitable fill or grading purposes.

B. Preliminary Rolling:

1. After site preparation to acceptable limits and before any fill or construction is placed, proofrolling of the entire surface to receive compacted fill shall take place with at least ten complete coverages of a 10 ton capacity roller, to obtain a firm unyielding subgrade. The CONTRACTOR shall notify the ENGINEER at least 72 hours in advance of proofrolling operation. The fill area shall be rolled in each of two perpendicular directions, and each pass of the proofrolling equipment shall overlap slightly the previous pass. To insure conditions along existing building walls, hand tamp the surface within 4' of all existing walls, also in two perpendicular directions, overlapping previous passes.

2. The compaction will be checked by the OWNER'S Soils Testing Contractor and fill shall not be placed until the compaction of subgrade is approved by the ENGINEER.

3. As the proofrolling operation progresses, and discloses soft spots or irregularities within the subgrade, they shall be excavated to firm material and then backfilled or leveled to grade with layers of approved fill material previously described, not exceeding loose lifts of approximately 8" and compacted to such a degree that the in-place dry density of the compacted fill shall not be less than 95% of the maximum dry density as determined by ASTM D698, Standard Proctor. This procedure is applicable to any soft spots discovered by handtamping along existing walls.

C. Moisture Control:

1. The control of moisture during the construction of the fills shall be based on the results of the Modified Proctor Compaction Tests, ASTM Designation D1557. Compaction curves resulting from tests on approved fill material or other suitable material shall be prepared by the Testing Agency to show the optimum water contents for compaction. The approved fill materials shall be placed at moisture contents within limits defined by the Modified Proctor Compaction Test such that the specified degree of compaction can be attained.

2. Should the fill material be of such moisture content at the time of placement that the above moisture criterion is not met, then immediate steps shall be taken to dry or to wet the material, as the need may be, to bring the moisture content within the tolerances as above described.

D. Placement of Materials and Compaction:

1. No fill material shall be placed on any point of the surface of the fill to be compacted which has free water standing on it or which is excessively wet, nor shall any fill be placed or compacted in a frozen condition or on top of frozen material.

2. If the moisture contents of the fill materials during placement are too low to achieve the specified degree of compaction, the surface of the loose fill shall be uniformly sprinkled to raise its moisture content approximately to the optimum content. Moisture contents of fill materials which are too high for proper compaction shall be reduced to approximately the optimum moisture content by harrowing and working the soil prior to compaction rolling.

3. At the end of each day's operation, the CONTRACTOR shall leave the surface of the fill in such shape so as to provide easy run-off for rainfall.

4. Completed work that fails to conform to the design requirements, as specified above, may lead to rejection of the work, and shall be repaired or replaced in a manner approved by the ENGINEER. Such work shall be executed by the CONTRACTOR at no additional expense to the OWNER, and shall include laboratory tests and costs for re-examination if necessary.

E. Site Grading:

1. Cut, fill, compact and grade project area to subgrade elevation. Grade so that any new grades will meet existing conditions evenly.

F. Excavation:

1. To the extent required under this Contract, all excavation shall be performed as outlined in this Section. All excavation shall be performed on the basis of UNCLASSIFIED MATERIAL.

2. Allow space for construction and inspection operations. Clean and shape bottom of excavation to solid and level surface.

G. Rough and Finish Grading, Outside Building Lines:

1. Fill materials outside the building lines shall be compacted to 95% of the Modified Proctor maximum density.

2. Grade finish uniformly with rounded surfaces at the tops and bottoms of abrupt changes of plane. Hand grade steep slopes and areas that are inaccessible for machine work.

3. Finish surfaces properly for landscaping, paving, or as indicated. Variation from a plane shall not exceed 1" in 10 feet. Protect graded areas from undue erosion, or repair and regrade. Refill where noticeable settlement occurs.

3.11 EXCAVATING AND GRADING TOLERANCES

		Elevation	Line
A.	Subgrade for Paving & Building Pads	+1"	N/A
		-2"	N/A
B.	All other Work	+2"	+6"
		-2"	-6"

3.12 TESTS AND INSPECTION

A. All testing during the excavation, placement of fill, and backfilling shall be performed by the OWNER'S Soils Testing Contractor. The CONTRACTOR shall extend his full cooperation so as to permit the safe and proper execution of field tests, and the procurement of samples for laboratory testing.

B. During the proofrolling operations and during the placement of all types of fill, including backfill to the extent required under this Contract, the OWNER'S Soils Testing Contractor and ENGINEER shall be present on the site for the purpose of inspecting the placement of the fill and for testing the in-place densities of the materials as they are compacted. None of these operations shall be performed without notifying the ENGINEER.

C. In-place density determinations shall be made by the OWNER'S Soils Testing Contractor at locations to be selected by the ENGINEER as typical of the fill being placed. Whenever in-place densities are found to be less than those specified for certain fill materials and for certain conditions, the ENGINEER may suggest immediate adjustments to the moisture content of the fill materials and/or additional rolling to produce the specified degree of density.

D. Copies of all tests and reports shall be submitted to the ENGINEER.

END OF SECTION 31 2200

SECTION 31 2220 - EARTHWORK FOR UTILITIES

PART 1 - GENERAL

1.1 SCOPE

A. Description of Work

1. Provide all labor, material and equipment to excavate pipe trenches and backfill after the installation of the pipe, all in accordance with the Drawings and as specified herein.

B. Related Work Specified Elsewhere

1. Submittals, Section 01 3300, SUBMITTAL PROCEDURES
2. Rock Excavation, Section 31 2230, ROCK EXCAVATION
3. Sanitary Sewer, Section 33 2551, SANITARY SEWERS AND APPURTENANCES
4. Piping, Section 33 2552 WATER MAINS AND APURTENANCES
5. Manholes, Section 33 2603 PRECAST UTILITY STRUCTURES
6. Section 32 3301, MISCELLANEOUS CAST-IN-PLACE CONCRETE
7. Repaving, Section 32 2575, PAVING AND RESURFACING.

1.2 LINES AND GRADES

A. Grades

1. Pipes shall be laid true to the lines and grades shown on the Drawings. The grade shown on the profile is the invert to which the Work must conform. Work not conforming to the lines and grades shall be removed and reinstalled to the proper depths and locations by the Contractor at his own expense. If field conditions hinder proper installation, it shall be brought to the attention of the Engineer. No charge for downtime will be allowed. Contractor must assist to achieve a proper resolution in a timely manner.

2. The Contractor is responsible for maintaining the line and grade. The pipe shall be checked at each manhole to assure that it is on the correct line and grade.

B. Locations of Lines

1. The locations of the proposed lines are shown on the Drawings.

2. The Engineer reserves the right to make changes in lines and grades of pipe lines when such changes may be necessary or advantageous.

C. Changes In Pipe Location or Grade

1. The Owner will allow no claims for changes in locations or grade unless such changes are made after trenching has been done. In such cases, the compensation will be determined in accordance with ARTICLE 11 of the GENERAL CONDITIONS, and if the Contractor fails to promptly notify the Engineer at the time of the change in accordance with ARTICLE 11 of the GENERAL CONDITIONS, the Contractor shall waive his rights for claims in accordance with ARTICLE 10 of the GENERAL CONDITIONS.

1.3 TRENCHING REGULATIONS

A. In open trenching, the Contractor shall be governed by the conditions, restrictions and regulations made by the Township. All such regulations shall be in addition to the ones set down in these Specifications.

PART 2 - PRODUCTS

2.1 ENCASEMENT AND TRENCH BACKFILLING MATERIALS

A. Suitable Materials (Trench Backfill in Grass Areas Only)

1. Materials including inorganic soils classified as CL, ML, SM, SC, SW, SP, GW, GP, GM and GC, or a combination of these group symbols, per ASTM D 2487. The materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest dimension.

B. Stone

1. Stone shall be AASHTO #8, #10 or PennDOT 1B, 2A, and 2B as noted on the Drawings.

C. Flowable Backfill

1. Flowable Backfill shall be Type C as specified in Section 220 of PennDOT Publication 408, latest edition.

D. Concrete

1. Concrete used for cradles, thrust blocks, or encasement shall be Class A concrete (3000) psi as specified in Section 32 3301, MISCELLANEOUS CAST-IN-PLACE CONCRETE. Tests of concrete for this usage are waived.

E. Sand

1. Material shall be free of ice, clay, organic matter or other objectionable material, and shall conform to the following standards:

a. 4.2.1 Gradation per ASTM C136:

SIEVE SIZE	PERCENT BY WEIGHT PASSING SIEVE
3/8"	100
#4	90-100
#50	10-40
#100	3-20
#200	0-15

b. 4.2.2 Sand Equivalent per ASTM D2419: 25 minimum
c. 4.2.3 Plasticity Index Per ASTM D4318: Non Plastic
d. 4.2.4 Moisture – Density per ASTM D1557: Maximum +2% of optimum, Minimum -5% of optimum.
e. 4.2.5 Any pipe sand bedding material retained on a #4 sieve, shall not contain angular material as described in ASTM D2488. Pipe sand bedding material which contains subangular, subrounded or rounded material, and conforms to Sections 4.2.1 and 4.2.2 is acceptable.

PART 3 - EXECUTION

3.1 EXCAVATION

A. General

1. Perform all excavation of every description and of whatever substances encountered to the depth shown on the Drawings.

2. All excavated materials not required for fill or backfill shall be removed from the site and disposed of as noted in paragraph 3.12 of this section.

3. All excavation shall be made by open cut. Side walls of trenches shall be kept vertical and shall be properly sheeted and braced.

4. Trenches shall be excavated true to line so that the trench width is not more than the width as specified in paragraph 3.13.B of this section.

5. Where damage is liable to result from withdrawing sheeting, the sheeting shall be left in place. Sheeting shall be left in place only when agreed to or requested by the Engineer.

6. Care shall be taken not to excavate below the depth specified.

B. Rock

1. Rock excavation, when needed, shall be done in accordance with Section 31 2230, ROCK EXCAVATION.

C. C. Excavation Below Grade

1. Where the bottom of the trench, by mistake of the Contractor, is taken out to a greater depth than specified for a given pipe bedding the trench shall be brought back to grade as follows:

   a. The over-excavation shall be filled with crushed stone so as to comply with the requirements for crushed stone foundation.

2. Refilling with earth to bring the bottom of the trench to the proper grade will not be permitted.

3. This additional material required due to the over-excavation shall be furnished and installed by the Contractor at his own expense.

D. Blasting

1. Blasting, when needed and permitted by the OWNER, shall be done in accordance with the Specification for Blasting in Section 31 2230, ROCK EXCAVATION.

3.2 EXCAVATION NEAR EXISTING STRUCTURES

A. Attention is directed to the fact that there may be water pipes, drains and other utilities in certain locations. Some of these have been indicated on the Drawings, but no attempt has been made to show all of the services, and the completeness or accuracy of the information given is not guaranteed.

B. In accordance with the PA One Call System, all water or other utility lines shall be located on the ground with pipe locating equipment well ahead of the work at all times. All such locations shall be plainly marked by coded paint symbols on pavement or by marked stakes in the ground. Such locations shall be established at least 50 feet in advance of all trench excavation. Arrangements for all such location work shall be provided by the Contractor at no cost.

C. As the excavation approaches pipes, conduits or other underground structures, digging by conventional trenching machine methods shall be done with extreme care. No extra compensation will be given if manual excavation is done to locate utilities and/or underground structures.

D. When excavating within 2 feet (vertical or horizontal) of a gas or oil line, the Contractor shall use the manual method of excavation. At no time will conventional trenching equipment be permitted under these conditions. No extra compensation will be given for this manual excavation.

E. Excavation near structures will not be allowed closer to the structure than the depth of the excavation below the bottom of the foundation without shoring the excavation with sheeting.

F. The Contractor shall carefully protect from disturbance and damage all land monuments and property markers until an authorized agent has witnessed or otherwise referenced their locations. These monuments and/or markers shall then only be removed when authorized by the agent or Owner. Monuments and/or markers shall be reinstalled by the Contractor to the satisfaction of the property owner or agent.

G. Contractor is responsible to call 911 1st if gas mains or services are hit. Work will be halted until the gas company comes to the site to temporarily or permanently repair.

3.3 PROTECTION OF EXISTING STRUCTURES

A. All existing pipes, poles, wires, fences, curbing, property-line markers and other structures which must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the Contractor.

B. In case of damage to any structure, the Contractor shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. If the owner of the structure wishes to make his own repairs, the Contractor shall reimburse the owner of the structure for all the time and materials required to make the repairs.

C. When the owners of the damaged structures do not wish to make the repairs themselves, all damage shall be repaired by the Contractor, or, if not promptly done by him, the Owner may have the repairs made at the expense of the Contractor.

D. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs.

E. The Contractor shall not be compensated for any additional work involved if the utilities or underground structure cross the trench line transversely above or below the pipe.

F. The Contractor is responsible to assure property owners have water and sewer services prior to completing work for the day.

3.4 CARE AND RESTORATION OF PROPERTY

A. Excavating machinery and cranes shall be operated with care to prevent damage to existing structures, paving and/or wires.

B. It is suggested that to protect the pavement and shoulders, all equipment should have rubber wheels or runners and should have rubber, wood or similar protective pads between the outriggers and the surface unless otherwise authorized by the Owner. In the event that other than rubber equipped machinery is authorized for use, the pavement and shoulders should be protected by the use of matting, wood or other suitable protective material having a minimum thickness of 4 inches. In any event it shall be the Contractor's responsibility to take whatever steps are necessary to protect pavement and shoulders.

C. The Contractor must exercise care not to damage paving, curb, inlets, sidewalks, etc., beyond the limits shown on the Trench Pay Widths. Any damages to areas outside the limits of the Trench Pay Width as shown on the Drawings shall be replaced in kind by the Contractor at his own expense, to the satisfaction of the Owner unless so indicated on the Drawings to be replaced.

D. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.5 TRENCHING

A. Trenches shall be dug to the depth required by the Contract Documents adding, however, to such depths the thickness of the pipe and the required bedding. The width of the trench (Trench Pay Width) shall be as described on Drawing.

B. During installation, upon encountering quicksand or a wet spongy material, the Contractor shall determine the actual depth of the soft material. Once the depth of the soft material has been determined, one of the following methods of construction shall be used as determined by the Engineer:

1. Installation by the quicksand excavation method

2. Crushed stone foundation

3. Concrete encasement

3.6 SHEETING AND SHORING

A. Where sheeting, shoring, bracing, or trench boxes are used, they must be designed by a Professional Engineer licensed to practice in the State of Pennsylvania. Said Engineer shall provide the Contractor with a certification signed and sealed by him stating that the design of the sheeting and bracing conforms to all applicable requirements of the Pennsylvania Construction Safety Code and the Occupational Health and Safety Act. Copies of this certification shall be submitted to the Engineer.

B. Trenches shall, at all times, be properly protected to prevent accidents, caving of the sides of the trench or breaking of the ground outside of the lines of the trenches proper or damage to buildings or other structures along the line of construction. Underground structures of all types shall be protected by the Contractor, who shall use all necessary shoring, bracing or other appliances for the protection of same. Care must be taken not to damage in any way water mains, water service pipes, drain pipes, sanitary or stormwater sewers, gas mains, oil mains, electric conduits or other structures encountered.

C. The Contractor must follow the proposed sheeting plans submitted. No deviations may be made from the filed procedure without first submitting a revised sheeting and bracing plan, signed and certified as required for the original submission, by the same licensed Professional Engineer who prepared the original submission.

D. No sheeting shall be left in place unless so authorized by the Engineer.

E. All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheeting shall be immediately backfilled with well-compacted material.

F. When installing pipe the sheeting and shoring shall not project below a point 1 foot above the top of pipe, except during quicksand excavation or to stabilize trench bottom.

G. If when installing pipe, sheeting must be placed below the pipe invert in order to stabilize trench bottoms. The sheeting shall be left in place from the trench bottom to a point 1 foot 6 inches above the top of the pipe, and the remainder of the sheeting cut and removed before final backfilling.

3.7 TRENCHING IN ADVANCE OF PIPE LAYING

A. The trench for the pipe lines shall not be opened for a distance of more than 100 feet at any one time. At no time will the Contractor be permitted to leave the trench open at the end of a working day.

B. If concrete is to be installed for pipe cradle or encasement, longer lengths of trench may be left open with the Owner's approval, provided that:

1. All trenching regulations are met (refer to para. 1.3, "Trenching Regulations")

2. All trenches are properly secured and protected.

3.8 KEEPING TRENCH DRY

A. All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during pipe laying period. Pipe installation may not continue until all water is removed form trench. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in compliance with the applicable local regulations of the appropriate governing body. The Contractor shall provide a minimum of two pumps for each trench opened in wet ground, one operating and one standby. The standby pump shall be of a size that will replace the largest operating pump.

B. The Contractor shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater or other water which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to a natural watercourse in accordance with the EROSION AND SEDIMENT CONTROL PLAN shown on the Drawings and noted in specification section

3.9 PIPE ENCASEMENT

A. General

1. Take care to avoid contact between the pipe and compaction equipment. The tampers shall be hand or pneumatic of the proper size to operate between trench wall and pipe without damaging the pipe.

2. Do not use compaction equipment directly over the pipe while placing the encasement to insure that such equipment will not damage or disturb the pipe.

3. Refer to Pipe Encasement and Backfill Details on Drawing.

4. Encasement material shall be spread in 4-inch layers and each layer shall be compacted with tampers until the required total depth of encasement has been built up.

5. The pipe encasement shall be compacted to not less than 95% of the maximum dry density as determined by ASTM D1557, achieved at each level on the day that the backfill is placed and compacted.

B. Concrete Encasement

1. Where specified or required in the field, the pipe shall be supported by Concrete Encasement.

2. See Detail “Pipe Encasement and Backfill Detail” on the Drawings.

3.10 BACKFILLING

A. General

1. No backfilling shall be done before the Engineer gives permission. All lateral connections shall be inspected by Owner’s representative prior to backfilling of trench. After the sewer main has been checked for alignment, the backfilling may be started. Backfill material may be deposited in trench either by hand or machine. Sufficient number of men shall be available to spread the backfill in uniform layers.

2. At least 48 inches of cover shall be provided before using mobile trench compactors of the hydrohammer or impactor type. These compactors shall only be used after the pipe has been properly backfilled in accordance with these Specifications.

3. Compaction by puddling or water jetting shall not be allowed.

B. Backfilling in Traffic Areas (Paved Streets, Paved Parking Lots, Alleys, Driveways, and Shoulders)

1. Backfilling Trench To Underside of Paving After Initial Backfilling (Select Backfill)

a. After the installation of the encasement has been compacted backfill, the remainder of the trench as noted on the Drawings compacted in layers not to exceed 12 inches using a mechanical tamper up to the bottom elevation of the pavement structure to 95% in place density to be achieved at each level on the day that the backfill is placed and compacted.

C. Backfilling in Paved Areas

1. When backfilling in paved areas, the backfill material shall be placed or stored on the side of the operation farthest from the road, metal or pavement unless otherwise authorized by the Owner and in such a manner that there will be no interference with the flow of water in any gutter, drain, pipe, culvert, ditch or waterway. The remaining excavated material must be removed from the site each day as the Work progresses.

3.11 COMPACTION AND TESTING IN PAVED AREAS

A. In all paved areas the backfill shall be thoroughly compacted over and around the pipe by use of vibratory tamping pads or where these cannot be used, by mechanical or hand tamping. Backfilling shall be compacted to not less than ninety-five (95%) percent of maximum dry density as determined by ASTM D1557. Compaction shall be achieved at each level of backfill on the day that the backfill is placed and compacted.

B. The optimum moisture content and the maximum density of each type of material used for trench backfill shall be determined by "Tests for Moisture-Density Relations of Soils, using 10 lb. Rammer and 18 inch Drop" (ASTM D1557 or AASHTO T-180).

C. The field moisture content of materials being compacted shall be determined by "Laboratory Determination of Moisture Content of Soil" (ASTM D2216). The field density of compacted material shall be determined by test for density of soil and aggregate in place by nuclear method (Shallow Depth) (ASTM D-2922).

D. A soils engineering and testing laboratory, as hired directly by the Owner, shall perform sufficient tests and inspection procedures both in the field and lab to insure that the provisions of this Specification are met.

E. After testing is completed and reports are provided, all subgrades below the paving will be examined by the Engineer before any paving is authorized.

3.12 DISPOSAL OF MATERIAL

A. Unsuitable soil (construction debris and unnatural materials) as defined in Specification Section 31 2200, Paragraph 2.04, will become the property of the Contractor, who is to dispose of the soils off site at the Contractor's selected approved disposal site.

3.13 MAXIMUM TRENCH WIDTH

A. The maximum trench widths set the limit of payment for various items as itemized below and noted on the details.

1. Trench Width as noted on the Drawings “Pipe Encasement and Backfill Details” shall be the Limit of Payment.

2. Typical paving cutbacks, both sides of trench: 12 inches

3. The Limit of Payment for paving over the trench shall be the trench width shown plus cut back on either side of the trench. (See drawing details).

4. Replacement work beyond Trench Width or Limit of Payment for paving shall be in accordance with Paragraph "Care and Restoration of Property."

B. Compaction Requirements for Soil Disposal Site

1. Refer to Specification Section 31 2200, SITE EXCAVATION AND EARTHWORK, paragraph 3.09.

END OF SECTION 31 2220

SECTION 31 2270 - EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work required by the governing regulations and obtained permits to prevent soil erosion, sedimentation, and pollution of waterways.

1.2 REGULATORY REQUIREMENTS

A. The erosion and sedimentation control measures are subject to inspection by State, County, and local regulatory agencies. The CONTRACTOR shall be fully responsible for constructing and maintaining the erosion and sedimentation control measures to the extent that they are, at all times, acceptable to the regulatory agencies. The CONTRACTOR shall be liable for payment of any fines or legal costs that the OWNER may incur as a result of the CONTRACTOR's failure to properly construct and maintain the erosion and sedimentation control measures.

1.3 RELATED SECTIONS AND REFERENCES

A. Section 31 2930 - Seeding

B. PennDOT Construction Specifications, Publication 408.

C. Pennsylvania Legal Code, Title 10, Chapter 102

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rock Construction Entrance: PennDOT Section 849

B. Pumped Water Filter Bag: PennDOT Section 855

C. Storm Inlet Protection: PennDOT Section 860.

D. Filter Fabric Fences: PennDOT Section 865.

E. Compost Filter Sock: PennDOT Section 867.

F. Temporary Sediment Trap Riser: PennDOT Section 874

G. Seed, fertilizer, mulch, and erosion control stabilization blankets: Section 31 2930 of these Specifications for more information.

PART 3 - EXECUTION

3.1 CONSTRUCTION SEQUENCE

A. Install all erosion and sedimentation control measures prior to start of clearing and earthwork operations.

B. Conduct construction operations in accordance with the following general sequence:

1. Construction of applicable erosion and sedimentation control measures including ditches and swales, filter fabric fences, stabilized construction roads, and sedimentation basins.

2. Clearing, removal of debris, and stockpiling of soil materials.

3. Excavation and embankment construction.

4. Construction of building, structures, pipelines, and other items required by the Contract Documents.

5. Backfilling, final grading, paving, seeding, and other ground stabilization.

6. Removal of temporary erosion and sedimentation control measures.

3.2 EXECUTION

A. Stabilize all temporary construction roads and laydown areas with Selected Material Surfacing.

B. Construct perimeter swales and ditches to intercept runoff and route it around excavations, stockpiles, and areas of exposed soil. Line swales and ditches with a synthetic ditch lining material.

C. Install filter fabric fences and compost filter sock.

D. Construct infiltration basin(s) to intercept runoff and to treat water pumped from excavations prior to discharging this water to natural drainage courses.

E. Place excavated material on the high side of the excavation, whenever possible, and confine the material so that it will not obstruct the normal flow in drainage courses.

F. Construct soil stockpiles so that side slopes are no steeper than 2:1. Where stockpiled materials will not be used within a 14-day period after the stockpile is completed, protect the material from erosion by means of jute netting, straw bales, excelsior blankets, or other erosion-resistant material.

G. Stabilize exposed soil by seeding or with rip rap within 14 days after completion of grading. Seed in accordance with Section 31 2930.

H. As any sediment is tracked onto or conveyed by other means onto any roadways or driveways, it shall be immediately removed. Removal may be completed through either the use of machinery or hand tools, but shall never be washed off the roadway into road side ditches, storm sewers, or surface waters. As a minimum, the CONTRACTOR shall sweep and vacuum all roadways and driveways used by any construction equipment at the end of each work day. Additional sweeping and vacuuming may be required as determined by the ENGINEER. As a minimum, the CONTRACTOR shall sweep and vacuum all roadways and driveways used by construction equipment, at the end of each workday. Additional sweeping and vacuuming may be required as determined by the ENGINEER.

I. The CONTRACTOR shall be responsible for the proper construction, stabilization and maintenance of all erosion and sedimentation pollution controls and related items.

J. Should any measure installed by the CONTRACTOR be incapable of either adequately removing sediment from on-site flows prior to discharge from the site or stabilizing the surfaces involved, additional measures shall be immediately implemented by the CONTRACTOR to eliminate all such problems.

K. If a sinkhole develops during construction, the CONTRACTOR shall immediately contact the Township and the ENGINEER.

L. Should unforeseen erosive conditions develop during construction, the CONTRACTOR shall take action to remedy such conditions and to prevent damage to adjacent properties as a result of increased runoff and/or sediment displacement. Stockpiles of wood chips, hay bales, crushed stone, and other mulches shall be held in readiness to deal immediately with emergency problems of erosion.

M. The CONTRACTOR is advised to become thoroughly familiar with the provisions of Appendix 64, Erosion Control Rules and Regulations, Title 25, Part 1, Department of Environmental Protection, Sub-Part C, Protection of Natural Resources, Article II, Water Resources, Chapter 102, Erosion and Sediment Control.

3.3 RESTORATION

A. After completion of construction, once ground cover has achieved stabilization, remove all temporary erosion and sedimentation control devices. Restore areas in which these devices were located to the original condition or to the condition called for by the Contract Documents.

END OF SECTION 31 2270

SECTION 31 2319 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction dewatering.

B. Related Requirements:

1. Section 01 3233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
2. Section 31 2000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review condition of site to be dewatered, including coordination with temporary erosion-control measures and temporary controls and protections.
3. Review geotechnical report.
4. Review proposed site clearing and excavations.
5. Review existing utilities and subsurface conditions.
6. Review observation and monitoring of dewatering system.

1.3 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.

4. Include written plan for dewatering operations, including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

B. Delegated Design Submittals: For dewatering system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Submittals:

1. Field quality-control reports.

B. Qualification Statements: For Installer and professional engineer.

C. Delegated design engineer qualifications.

D. Existing Conditions: Using video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

E. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer: An experienced installer that has specialized in design of dewatering systems and dewatering work.
2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.
3. Land Surveyor: A professional land surveyor who is legally qualified to practice in state where Project is located.

1.6 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering in accordance with the performance requirements.
2. The geotechnical report is included elsewhere in Project Manual.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design dewatering system.

B. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.

2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 31 1000 "Site Clearing," during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below groundwater level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of groundwater and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks m

C. onthly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

D. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

E. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 31 2319

SECTION 31 2923 - LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Final grade topsoil for finish landscaping.

1.2 RELATED SECTIONS

A. Section 01 4000 - Quality Requirements

B. Section 31 2200 - Site Excavation and Earthwork

C. Section 31 2220 - Earthwork for Utilities

D. Section 32 2575 - Paving and Resurfacing

E. Section 31 2930 - Seeding

F. Section 31 2950 - Trees, Plants and Ground Cover

PART 2 - PRODUCTS

2.1 MATERIAL

A. Topsoil:

1. Existing excavated topsoil stockpiled on site.

2. Imported friable loam; reasonably free of subsoil, roots, grass, excess amount of weeds, stone limited to 1 inch maximum size, foreign matter; pH of 5.5 to 7.5 containing a minimum of 4 percent and maximum of 25 percent organic matter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify fill material to be reused, is acceptable.

B. Verify site and trench backfilling has been completed and inspected.

C. Verify subsoil base has been contoured and compacted.

D. Beginning work of this section means acceptance of existing conditions.

3.2 SUBSOIL PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches and stones in excess of 1/2 inch in size. Remove subsoil contaminated with petroleum products.

C. Scarify subgrade to depth of 4 inches where topsoil is scheduled. Scarify in areas where equipment is used for hauling and spreading topsoil and has compacted subsoil.

3.3 PLACING TOPSOIL

A. Place topsoil in areas where seeding and planting is required.

B. Use topsoil in relatively dry state. Place during dry weather and on unfrozen subgrade.

C. Frozen topsoil shall not be spread.

D. Fine grade topsoil eliminating rough or low areas. Maintain profiles and contour of subgrade.

E. Remove roots, weeds and foreign material while spreading.

F. Manually spread topsoil close to trees, plants, fences and buildings.

G. Lightly compact placed topsoil.

H. Remove surplus subsoil and topsoil from site.

I. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.4 TOLERANCES

A. Top of Topsoil: Plus or minus 1/2 inch.

3.5 SCHEDULE OF LOCATIONS

A. Compacted topsoil thickness.

1. Seeded Grass: 6 inches

2. Landscaped Areas: 24 inches

3.6 PROTECTION

A. Protect landscaping and other features remaining as final work.

B. Protect existing structures, fences, sidewalks, utilities, paving and curbs.

END OF SECTION 31 2923

SECTION 31 2930 - SEEDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fertilizing.

B. Seeding, Hydroseeding.

C. Mulching.

D. Maintenance.

1.2 RELATED SECTIONS

A. Section 31 2220 - Earthwork for Utilities

B. Section 31 2923 - Landscape Grading

C. Section 31 2950 - Trees, Plants, and Ground Cover

1.3 REFERENCES

A. Federal Specification FS 0-F-241 - Fertilizers, Mixed, Commercial.

1.4 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.5 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer composition and herbicide composition.

1.6 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weights, date of packaging, and location of packaging.

1.7 TESTS

A. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

1.8 MAINTENANCE DATA

A. Submit maintenance data for continuing Owner maintenance.

B. Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 6000.

B. Store and protect products under provisions of Section 01 6000.

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.10 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SEED

A. All seed used shall be labeled in accordance with the U.S. Department of Agricultural Rules and Regulations under the Federal Seed Act in effect at the time of purchase. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed shall not be more than two (2) years old and shall be retested for germination rate no more than ninety (90) days prior to use.

B. Inert matter shall not exceed 15%. Blue Tag Certified Seed shall be supplied wherever possible.

2.2 SEED MIXTURE

A. Lawn Seed

	% by Weight	Minimum % Purity	Minimum % Germination	Maximum % Weed Seed
Kentucky Bluegrass (2 or more varieties – none greater than 25% of total)	50	90	80	0.20
Pennfine Perennial Rye Grass	20	95	90	0.15
Pennlawn and Fescue	30	98	85	0.25

B. Special Areas - swales, pond embankments, levees, diversion channels, and occasional water flow areas.

	% by Weight	Minimum % Purity	Minimum % Germination	Maximum % Weed Seed
Kentucky 31 Tall Fescue	80	98	85	0.25
Pennfine Perennial Rye Grass	20	95	90	0.15

2.3 SOIL MATERIALS

A. Topsoil

1. Excavated from site and free of weeds.

2. Imported

2.4 ACCESSORIES

A. Mulching materials shall be unrotted salt hay, hay or small grain straw, free from weeds, foreign matter detrimental to plant life, and dry. Chopped cornstalks are not acceptable.

B. Hydrated lime or agricultural grade limestone.

C. Fertilizer: Federal Specification FS O-F-241, Type recommended for grass, with fifty percent of the elements derived from organic sources; to the following proportions.

1. Nitrogen 0 percent, phosphoric acid 20 percent, soluble potash 20 percent.

2. Nitrogen 10 percent, phosphoric acid 10 percent, soluble potash 10 percent.

D. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

E. Erosion Fabric: Jute matting, open weave.

F. Stakes: Softwood lumber, chisel pointed.

G. Twine: Inorganic fiber.

H. Mulch netting – staple paper, jute, cotton, or plastic netting to the soil surface. Use degradable netting in areas to be mowed.

I. Synthetic liquid mulch binders - May be used to anchor salt hay, hay, or straw mulches

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that prepared soil base is ready to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions.

3.2 PREPARATION OF SUBSOIL

A. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove subsoil contaminated with petroleum products.

B. Scarify subgrade to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.3 PLACING TOPSOIL

A. Place topsoil in areas where seeding is scheduled.

B. Use topsoil in relatively dry state. Place during dry weather and on unfrozen ground.

C. Frozen topsoil shall not be spread.

D. Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade.

E. Remove stone, roots, grass, weeds, debris, and foreign material while spreading.

F. Manually spread topsoil around trees, plants, building and fences to prevent damage.

G. Lightly compact placed topsoil.

H. Remove surplus subsoil and topsoil from site.

I. Leave stockpile area and site clean and raked, ready to receive landscaping.

J. Compacted topsoil thickness for seeded grass areas shall be 4 inches and for landscaped areas shall be 12 inches.

3.4 FERTILIZING

A. After spreading and raking the topsoil, and prior to rolling, the following shall be spread and mixed thoroughly into the upper three (3) to four (4) inches of topsoil:

1. Hydrated lime or Agricultural grade limestone - 150 lbs. per 1,000 sq. ft. or at a rate suggested from the results of a soil test.

2. 10-20-20 Fertilizer - at a rate of 25 lbs. per 1,000 sq. ft.

B. Lightly water to aid the dissipation of fertilizer.

C. Immediately before seeding, the following shall be spread and mixed thoroughly into the upper one (1) inch of topsoil:

1. 10-10-10 Fertilizer - at a rate of 25 lbs. per 1,000 sq. ft.

D. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

3.5 SEEDING (AREAS LESS THAN 1,000 SF)

A. Apply seed at a rate as indicated below evenly in two intersecting directions. Rake in lightly. Do not seed area in excess of that which can be mulched on same day.

1. Lawn Seed: 2.5 lbs. per 1,000 sq. ft.

2. Special Areas: 2.0 lbs. per 1,000 sq. ft.

B. B. Planting Season:

1. February 15th to May 1st

2. August 15th to October 15th

C. Do not sow immediately following rain, when ground is too dry, or during windy periods.

D. Immediately following seeding, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.6 HYDROSEEDING (AREAS GREATER THAN 1,000 SF)

A. Apply seeded slurry at a rate as indicated below evenly in two intersecting directions, with a hydraulic seeded. Do not hydroseed area in excess of that which can be mulched on same day.

1. Lawn Seed - 2.5 lbs. per 1,000 sq. ft.

2. Special Areas - 2.0 lbs. per 1,000 sq. ft.

B. Immediately following seeding, apply mulch to a thickness of 1/8 inch. Maintain clear of shrubs and trees.

C. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

D. Wood cellulose fiber, applied at a rate of 1,500 lbs. per acre, may be applied as an integral part of the slurry in lieu of straw mulching. Synthetic mulch binder, such as Curasol, DCA-70, Terra-tack, or an approved equal shall be used per manufacturer's instructions to anchor the mulch. Use is limited to flatter slopes and during optimum seeding periods in spring and fall.

3.7 SEED PROTECTION

A. Identify seeded areas with stakes and string around area periphery.

B. Mulch anchoring shall be accomplished immediately after placement to minimize loss by wind or water. This may be done by one of the following methods depending upon the size of slopes and costs:

1. Synthetic binders - such as Curasol, DCA-70, Petroset, or Terra-Tack applied as recommended by the manufacturer.

2. Mulch netting - lightweight biodegradable paper, plastic or cotton netting placed over mulch and anchored per manufacturer's specifications. Use a degradable netting in areas to be mowed.

3. Peg and twine - Drive 8 to 10 inch wooden pegs to within 2 to 3 inches of soil surface at 4 foot intervals in all directions. Stakes may be driven before or after applying mulch. Secure mulch to soil by stretching twine between pegs in a crisscross and square pattern. Twine to be secured by twisting two or more turns around each peg.

4. Applications should be heavier at the edges where wind catches the mulch, in valleys, and at crests of banks. Remainder of area should be uniform in appearance.

C. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

D. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

E. Secure outside edges and overlaps at 36 inch intervals with stakes.

F. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

G. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.8 TEMPORARY SEEDING

A. All areas disturbed by on-site work that will not be constructed immediately shall be temporarily stabilized.

B. Fertilizing:

1. Spread and mix the following into the topsoil.

a. Agricultural grade limestone or equivalent to 50 percent calcium plus magnesium oxides, applied at a rate of 1 ton per acre.

b. Fertilizer: Apply 10-20-20 Fertilizer, or equivalent, at the rate of 150 lbs. per acre.

C. Seeding as indicated below

1. Optimum seeding dates are February 15 through May 1 or August 15 through October 15 for the following species:

Species	Pounds per Acre	Optimum Seed Depth
Annual Ryegrass	40	0.5 inch
Perennial Ryegrass	40	0.5 inch
Oats	86	1.0 inch
Barley	96	1.0 inch

2. Optimum seeding dates are May 1 through August 15 for the following species:

Species	Pounds per Acre	Optimum Seed Depth
Pearl Millet	20	1.0 inch
Sudan Grass	30	1.0 inch
Millet (German or Hungarian)	30	1.0 inch
Weeping Lovegrass	5	1.0 inch

3. Double the above optimum seed depths for use when in sandy soils.

3.9 MAINTENANCE

The CONTRACTOR is responsible to:

A. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming.

D. Water to prevent grass and soil from drying out.

E. Roll surface to remove minor depressions or irregularities.

F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

G. Immediately reseed areas which show bare spots.

H. Protect seeded areas with warning signs during maintenance period.

END OF SECTION 31 2930

SECTION 31 2950 - TREES, PLANTS, AND GROUND COVER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Mulch.

C. Maintenance.

1.2 RELATED SECTIONS

A. Section 31 2200 - Site Excavation and Earthwork

B. Section 31 2220 - Earthwork for Utilities

C. Section 31 2923 - Landscape Grading: Preparation of subsoil and placement of topsoil.

D. Section 31 2930 - Seeding.

1.3 REFERENCES

A. ANSI Z60.1 - Nursery Stock.

1.4 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.5 NOMENCLATURE:

A. The scientific and common names used for the plants required under this Contract are generally in conformity with the approved names given in the Standardized Plant Names published by the American Joint Committee on Horticultural Nomenclature. The names of varieties not included therein are to be generally in conformity with names accepted in the nursery trade.

1.6 SUBMITTALS

A. The Contractor shall furnish the Engineer complete and detailed information concerning the source of supply for each item of plant material. The Contractor shall also provide a schedule of delivery and planting dates which shall be subject to the review of the Engineer.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit instructions for continuing Owner maintenance under provisions of Section 01 7823.

1.8 QUALITY ASSURANCE

A. Nursery: Company specializing in growing and cultivating the plants specified in this Section with minimum three years' experience.

B. Installer: Company specializing in installing and planting the plants specified in this Section with minimum three years' experience.

C. All planting stock shall be available for review in the nursery before it is dug.

D. All planting stock shall conform to the laws of Pennsylvania. Each shipment, invoice, or order of plants shall be declared and certified free of disease and insect pests of all kinds. All necessary inspection certificates shall accompany each shipment, invoice or order of plants and shall be given to the Engineer upon arrival at the points of delivery.

1.9 REGULATORY REQUIREMENTS

A. Comply with regulatory requirements for fertilizer composition.

B. Plant Materials: Described by American Standard for Nursery Stock, ASTM Z60.1; free of disease or hazardous insects.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver stone and protect products at site under provisions of Section 01 6000.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. Protect plants until planted.

D. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.11 PLANTING REQUIREMENTS

A. All planting shall be performed within normal planting seasons and then only when local climatic and soil conditions favor satisfactory planting operations. Beginning and ending of each planting season will be determined by the Engineer.

B. Do not install plant life when ambient temperatures may drop below 35 degrees F or above 90 degrees F.

C. Do not install plants when wind velocity exceeds 30 mph.

1.12 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with installation of underground utilities, piping and seeding.

1.13 MAINTENANCE SERVICE

A. Maintain plant life until plants are well established and exhibit a vigorous growing condition.

B. Maintenance to include:

1. Cultivation and weeding plant beds and tree pits.

2. Application of herbicides for weed control in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.

3. Application of pesticides in accordance with manufacturer's instructions. Remedy damage from use of pesticides.

4. Irrigating sufficient to saturate root system.

5. Trimming and pruning, including removal of clippings and dead or broken branches, and treatment of pruned areas or other wounds.

6. Disease control.

7. Maintaining wrapping, guys, and stakes. Repair or replace accessories when required.

1.14 WARRANTY

A. Provide a warranty on work of this Section for a minimum one year including one continuous growing season. Commence warranty on date identified in the Certificate of Substantial Completion.

B. Warranty: Include coverage of plants from death or unhealthy conditions.

C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

PART 2 - PRODUCTS

2.1 GROUND COVER

A. On all slopes greater than 3:1, non-mowed areas and as indicated on Drawings.

B. Plants:

1. Vinca Minor (Periwinkle)

a. Plant at 6" center to center both ways.

2. Penngift Crown Vetch

a. Inoculate in accordance with manufacturer's directions for broadcasting.

b. Inoculate at four (4) times manufacturer's rate for hydroseeding. If fertilizer is combined with inoculant in slurry, after 1 hour add a new supply of inoculant.

c. Apply at 2 lbs. per 1000 sq. ft.

2.2 PLANT MATERIALS

A. Plant material shall conform to the requirements and the measurements indicated on the Drawings and/or Plant List, in addition to the following requirements.

1. Plant materials are acceptable only within the same Plant hardiness zone as, or colder than, where project is located.

2. Plant material shall be measured when the branches are in their normal position. No pruning shall be done before the plant materials are delivered to the Site. Clipped or sheared plants are not acceptable. Plant materials shall be natural in habit of growth and full bodied.

3. The accuracy of varieties and species specified for plant material shall be Contractor's responsibility.

4. If a discrepancy occurs between the Drawings and the Plant List, the quantities shown on the Drawings shall govern.

5. Plant materials will be reviewed in the nursery and re reviewed at the Site by the Engineer. Plants, if rejected, shall be removed immediately from the site.

6. The Engineer, at his or her option, may accompany the Contractor on inspection trips to the nursery. The Engineer may select plants at nursery on basis of their proper formations visually. Contractor shall inspect the selected plants on basis that plants are free of disease and otherwise conform to requirements of Contract Documents.

7. All plants shall be nursery-grown, freshly dug, with a shape and form typical of the species.

8. Trees and shrubs where used in symmetrical rows shall be required to match in height, spread and branching habit as nearly as possible.

9. No substitutions of genus, species or variety will be permitted without written permission from the Engineer.

10. Evergreen shrubs up to 30", deciduous shrubs up to 42" and trees up to 1 1/2" caliper will be accepted as container plants in lieu of B&B stock providing they are delivered to the site in their rot resistant containers.

11. Balled and burlaped plants shall be delivered with hard, compact, natural balls of earth of the sizes specified, wrapped and tied in burlap or other suitable material.

12. Unless specifically excused on the Drawings, all plant materials shall be balled and burlaped to no less than A.A.N. standards; oversize balls will not be justification for additional charges to the Owner.

13. All field dug materials such as shade trees, ornamental trees and large shrubs, shall be root pruned by the Nurseryman no less than four (4) weeks before that material is to be balled and burlaped.

14. All crowns of shade trees will be full, symmetrical and densely foliated; there will be no flat sides or large voids in the overall appearance.

15. Unless otherwise indicated, all shade trees shall be single leader and straight trunked. Smooth-barked species shall have no scars in the clear trunk area. All trunks shall be free from cuts, sun scald, canker, nail (or insect) holes, frost cracks, or annual conks. All pruning cuts shall be flush with the trunk. All fresh wounds greater than 3/4" diameter shall be sealed with asphaltic tree wound dressing. There will be no old wounds which have not completely callused closed. Graft unions shall be smooth; scion and stock shall be the same diameter.

16. All evergreen trees shall have single straight leaders and symmetrically tapered trunks. There shall be no frost cracks or open wounds which have not been callused closed. There shall be no girdling wounds, insect holes or annual conks.

17. For all practical purposes, evergreen trees shall have foliage full to the ground. Bottom branches which are damaged during transit or installation and must consequently be removed are justification for rejection, if pruning those branches will destroy the overall form of the tree.

18. All plants furnished shall be free of all disease, insects, galls or other infestations.

2.3 SOIL MATERIALS

A. Topsoil: Excavated from site or imported as required.

2.4 MULCH MATERIALS

A. Mulching Material: ground bark, free of growth or germination inhibiting ingredients.

2.5 TREE STAKES:

A. Refer to Drawings.

2.6 PEAT MOSS:

A. Peat Moss shall be a mixture of partially decomposed reed-sedge and sphagnum moss peat, yellow-brown in color, free from lumps, roots and stones, and meeting the following analysis:

Organic Matter:	On dry weight basis - 90% or better.
Moisture Absorption:	On dry weight basis of own weight - 450%.
pH Factor:	3.5 to 5.5

2.7 BACKFILL MIX:

A. Backfill Mix for backfilling around tree balls shall be a mixture of volume of the following materials in quantities specified: 1/5 peat moss, 4/5 topsoil. Backfill Mix by analysis shall have at least 15% organic matter.

B. Add fertilizer as specified below. Adjust pH of backfill mix with lime or Sulphur as required for plant materials specified.

2.8 FERTILIZER:

A. Fertilizer shall be Agriform 21 gram tablets, slow release, 20-10-5 plus iron analysis or approved equal.

B. Rate of application:

1. Agriform Tablets: one tablet per ¼" trunk diameter of trees or shrubs. In case of multiple stems, the diameter will be a cumulative measurement.

2. Bulk fertilizer: 15 lbs. of 20-10-5 fertilizer per cubic yard of backfill

2.9 ANTI-DESICCANT:

A. Anti-desiccant shall be "Wilt Pruf" as manufactured by Nursery Specialty Products of New York, or approved equal.

2.10 WATER:

A. Provide hoses and other watering equipment required to transport water from off site to the planting work. Coordinate timing of plant installation with water availability. No water is presently available on-site.

PART 3 - EXECUTION

3.1 LOCATION

A. The locations for specific planting are shown on the Drawings.

3.2 PLANTING

A. The Contractor will plant the plants, trees, and shrubs in accordance with the standard practice of American Association of Nurserymen.

3.3 DIGGING AND MOVING PLANT MATERIALS:

A. Take customary precautions according to standards of American Association of Nurserymen in preparing plants for digging, moving, transporting, on site storage and planting.

B. Dig in a manner to retain as many fibrous roots as possible. Spray with anti-desiccant at nursery before moving, in strict accordance with manufacturer's recommendations. Apply as required with spray equipment over trunks, branches, twigs and foliage.

C. Ball and burlap all plants, unless otherwise stated, with firm, natural ball of soil of sufficient breadth and depth to include roots. Burlap and rope the entire earth ball. Mushy or badly cracked earth balls will not be acceptable.

D. Prevent injury to plant material when digging, moving, transplanting, unloading and planting.

E. Plants will be handled and protected at all times so that the roots or balls are not exposed to drying winds or sun. Plant materials with permanently wilted crowns or dehydrated roots will be rejected.

F. Plants shall be dug and handled with reasonable care and skill to prevent injuries to the trunk, branches and roots, and shall be packed in an approved manner to assure arrival at the project site in good condition. They will be freshly dug and moved from their original nursery or a suitable healed in location and planted on the site within forty eight (48) hours. All plants will be moved in closed or covered vehicles. Plant materials may be tied to aid in transit. It is the Contractor's responsibility that no branches will be broken, that they will return to their natural position within twenty four (24) hours, and that no trunks are scarred. No nails shall be driven into tree trunks.

3.4 PLANTING:

A. The Contractor shall stake out the location for all trees and shrubs at the site as a part of this Contract. All tree locations shall be staked with a minimum of 2" x 2" by 6' long wood stakes. Shrubs shall be staked with 2" x 2" by 3' long stakes.

B. The Engineer shall review staked out work prior to planting operations and give directions for plant orientation and other matters involving design.

C. Take customary precautions according to standards of the American Association of Nurserymen in preparing plants for digging, moving, transporting, on site storage and planting.

D. Prevent injury to plant material when digging, moving, transporting, unloading and planting.

E. Test all planting pits for proper drainage before installation. Notify Owner of poor drainage areas and corrective action required.

F. Before placing trees or shrubs into pits, place a layer of topsoil into bottom of pit six (6") inches deep and tamp to prevent settlement.

G. The plant pit shall be filled with backfill material (4/5 topsoil, 1/5 leaf compost) and placed in layers around the roots or ball. Each layer shall be carefully tamped in place in a manner to avoid injury to the roots or ball or disturbing the position of the plant. When approximately two thirds of the plant has been backfilled, the pit shall be filled with water and the soil allowed to settle around the roots. B&B plants shall have all twine, wire and burlap cut away or folded back from the top of the ball and trunks before applying the water. Failure to comply is basis for rejection for all suspected material as deemed by the Engineer. After the water has been absorbed, the plant hole shall be filled with backfill mixture, fertilizer added, and tamped lightly to grade.

H. The Engineer shall be notified to observe backfilling of topsoil or backfill mix in all planting beds prior to any backfilling operations within these beds. If Engineer is not notified to observe backfill operations, exploratory digging, if deemed necessary, shall be made at the expense of the Contractor.

I. Plant material shall be planted as promptly as possible and not later than seven (7) days after plant material has been dug in the nursery. Upon delivery to the site, unless planted the day of delivery, pile earth or mulch around the earth ball so that water evaporation and soil and root drying are kept to a minimum. Plant materials may be subject to re-inspection by the Engineer before they are planted.

J. Mulching All trees and shrub masses, as shown on the Drawings, shall be mulched with 2" of mulch (compacted depth) over all areas. All surfaces are to receive mulch and shall be raked off smooth and free of all rocks and debris as previously specified. Planting beds shall not be accepted until a full 2" depth of mulch is applied. Planting beds shall be supplemented to a full 2" depth before final acceptance at the end of the guarantee period.

3.5 PRUNING:

A. Plant materials shall be neatly pruned to preserve the natural character of the plant and in a manner appropriate to the particular requirements of each plant, at the time designated by, and to the satisfaction of the Engineer. No new plants shall be pruned prior to delivery.

B. Broken or badly bruised branches shall be removed with a clean cut. In general, at least one-third (1/3) of the wood of deciduous plants shall be removed by thinning and tipping of branches. Remove any dead branches by cutting flush with trunk of main limb. All pruning shall be done with sharp tools.

C. Remove leaves from deciduous trees that curl and/or turn brown. Keep newly planted trees well-watered.

D. Pruning cuts over 3/4" in diameter shall be painted over with an asphaltic base tree paint specifically manufactured for the painting of tree wounds.

E. Remove lower limbs on deciduous shade trees adjacent to sidewalks and paths up to a height of 6' 8" or as otherwise directed by the Engineer.

F. Do not shear plant material.

3.6 GUYING AND STAKING:

A. Refer to Drawings.

3.7 WRAPPING:

A. Not required.

3.8 CLEAN UP:

A. Upon completion of work, the premises shall be left in a neat and orderly condition.

B. Remove all construction material, trash, paper, ribbons, etc. from all mulched beds, as required.

3.9 MAINTENANCE PRIOR TO THE REVIEW TO DETERMINE BEGINNING OF GUARANTEE PERIOD:

A. The Contractor shall maintain all planting by watering, fertilizing, disease control, pruning, weeding, etc. so as to keep the completed work and/or incomplete work in a clean and neat condition at all times.

3.10 REVIEW OF WORK TO DETERMINE THE BEGINNING OF GUARANTEE PERIOD:

A. Review of the work to determine its completion for beginning the one year guarantee period will be made by the Owner and Engineer upon written notice requesting such review submitted by the Contractor at least ten (10) days prior to the anticipated date.

B. After review, the Contractor will be notified of the date that the work has been accepted for beginning the guarantee period or, if there are any deficiencies, a list to be corrected prior to the beginning of the guarantee period.

3.11 MAINTENANCE

A. The Contractor shall maintain planting for one year and shall replace any plants, shrubs, and trees that have died or do not appear healthy and unlikely to survive after that date.

END OF SECTION 31 2950

SECTION 32 2575 - PAVING AND RESURFACING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Temporary Paving

B. Permanent Paving

1.2 RELATED SECTIONS

A. Section 31 2200 - Excavation and Earthwork

B. Section 31 2220 - Earthwork for Utilities

1.3 REFERENCES

A. PennDOT Construction Specifications Publication 408

B. PennDOT Standards for Roadway Construction, Publication 72M (PennDOT RC-Series)

C. PennDOT Publication 213 - Work Zone Traffic Guidelines

D. PennDOT Publication 242 - Pavement Policy Manual, 2015 Edition

1.4 QUALITY ASSURANCE

A. Perform work in accordance with PennDOT Specifications and Publications.

B. Obtain materials from same source throughout.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable standards for paving work on public and private property.

1.6 TESTS

A. Testing and analysis will be performed under provisions of Section 01 4000, QUALITY REQUIREMENTS.

B. Bituminous Concrete Paving

1. Suppliers invoices shall contain a statement of certification that the materials meet the above-noted requirements.

1.7 SUBMITTALS

A. Submit product data under provisions of Section 01 3300.

1.8 JOB CONDITIONS

A. Control of Traffic:

1. Take measures to control traffic during repaving operations. Do not allow traffic on repaved areas until authorized by the ENGINEER.

2. Employ traffic control measures in accordance with PENNDOT Publication 213 - "Work Zone Traffic Guidelines", latest edition.

B. Restore all existing paving outside the limits of the work that is damaged by the CONTRACTOR's operations, to its original condition at the expense of the CONTRACTOR.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials to be used shall meet the requirements of PennDOT Publication 408.

2.2 EQUIPMENT

A. All bituminous material shall be machine laid in accordance with PennDOT Publication 408.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that the compacted subgrade meets the requirements of Section 31 2200 or Section 31 2220, before beginning work.

B. Verify gradients and elevations of subgrade are correct.

C. Beginning of installation means acceptance of subgrade.

3.2 PREPARATION

A. Prepare existing surfaces for the laying of permanent pavement as required in PennDOT Publication 408.

B. If milling of one or more lanes of roadway surface is required, follow PENNDOT Specification 408, Milling of Bituminous Pavement Surfaces.

3.3 TEMPORARY PAVING

A. At the end of each work day, the contractor shall either backfill the trench completely to the road surface or securely install steel plates to safely allow vehicular traffic. The backfill material or plate is to be maintained until the temporary paving is installed.

B. Install temporary restoration materials on Municipal Streets by the end of each week of completed of trench backfilling.

C. Temporary restoration may be required immediately (daily) by the Engineer where field conditions (grade, traffic, weather, etc.) dictate.

D. Shape and compact subgrade material, then place and compact subbase material to the required thickness shown on the Drawings.

E. Place temporary paving material as required and shown on the Drawings. Compact to required minimum thickness with trench roller having minimum 300 pounds per inch-width of compaction roll.

F. Continuously maintain temporary paving to the satisfaction of the ENGINEER.

G. Temporary pavement thickness for all paved surfaces shall be as detailed on the drawings.

H. Trenches can be temporarily restored by placing and compacting a minimum three inches (3") PennDOT Bituminous Stockpile Patching Material (Cold Patch) if the temporary trench restoration is completed after the annual cutoff date (October 31) for hot bituminous applications but only if hot bituminous material is unavailable.

I. The Contractor shall be responsible for monitoring and maintaining all trench settlement at all times until the permanent trench restoration is completed and accepted by the Township. Any low spots in temporary pavement must be addressed by the Contractor the day of notification by owner or the Engineer.

J. Valve boxes or manhole rims and covers shall be flush with the temporary paving grade, but no lower than ½". Assure that all valve boxes are plumb and operating nuts are accessible.

K. On a weekly basis, the Contractor and the Engineer shall review all in-place temporary paving on the project. As necessary, the Contractor shall deploy multiple crews for the purpose of temporary paving maintenance.

3.4 PERMANENT PAVING

A. Trim existing paving a minimum of one (1) foot back from damaged areas adjacent to the outside edge of the trench. Cut straight joint lines and right angle offsets.

B. Remove temporary paving material from trench. Construct permanent base and surface courses to the required compacted thickness shown on the Drawings. Backfilling shall be in accordance with the Backfill Schedule in Section 31 02200, and in accordance with Publication 408 Specifications.

C. Maintain permanent paving to the satisfaction of the ENGINEER and the local and State road departments throughout the contract maintenance period. Unless otherwise specified, the maintenance period shall be two (2) years, following final inspection and approval.

D. Bituminous PG64 22 sealer 12" wide shall be placed on all pavement joints or adjacent to curbs, gutters, utilities and structures. Rubberized sealant materials shall not be used, unless approval obtained by Township.

E. Permanent pavement thickness for all paved surfaces shall be as detailed on the drawings. In no case shall the permanent pavement thickness be less than the existing thickness.

3.5 MILLING

A. Milling, where indicated on the Drawings, shall be to the depth indicated and be in accordance with Section 491, MILLING OF BITUMINOUS PAVEMENT SURFACE in Commonwealth of Pennsylvania Department of Transportation Specifications, Publication 408.

B. Materials removed shall become the property of the Contractor.

3.6 OVERLAY

A. Where a surface course is required over existing roads, the surfaces to be covered shall be cleaned of all foreign substances and any irregularities removed or filled in. A tack coat shall be applied in accordance with Section 460, BITUMINOUS TACK COAT, in Commonwealth of Pennsylvania, Department of Transportation Specifications, Publication 408, after which the surface course will be applied in accordance with the wearing course specifications.

1. The overlay shall be compacted to at least 95% of the accepted density established by the Marshall method at the time of the approval of the mixture.

B. Where the overlay meets the existing paving a neat cut shall be made in the existing surface in accordance with the construction details.

C. Where overlays are to be placed over existing paving, the base and binder trench paving shall be installed such that the top of the binder paving is flush with existing adjacent paving.

3.7 SEALING

A. All joints between the new paving and the existing paving and where the new paving abuts other materials such as curbs and manhole frames shall be sealed with PADOT asphalt cement PG 64-22.

3.8 PAVEMENT MARKING

A. Replace and reinstall pavement markings in the work area. The pavement markings are to be as noted on the Drawings or as determined in the field by the Owner.

B. Material and workmanship shall be in accordance with the Pennsylvania Department of Transportation's latest copy of Publication 408.

END OF SECTION 32 2575

SECTION 32 3301 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE

A. Description of Work

1. Provide all labor, material and equipment to furnish and install all concrete as shown on the Drawings and specified herein.

1.2 APPLICABLE SPECIFICATIONS

A. The Contractor shall follow the practices and standards of the following American Concrete Institute Specifications which are made part of this specification:

1. ACI-214, "Recommended Practice for Evaluation of Compression Test Results of Field Concrete"
2. ACI-304, "Recommended Practice for Measuring, Mixing and Placing Concrete"
3. ACI-305, "Recommended Practice for Hot Weather Concreting"
4. ACI-306, "Recommended Practice for Cold Weather Concreting"
5. ACI-613, "Recommended Practice for Selecting Proportions for Concrete"

B. ASTM C150, "Specification for Portland Cement"

C. ASTM C33, "Specification for Concrete Aggregates"

D. ASTM A615, "Specification for Deformed Billet Steel Bars for Concrete Reinforcement"

1.3 SUBMITTALS

A. All submittals shall be in accordance with Section 01 3300, SUBMITTAL PROCEDURES.

B. Submittals shall include, but also not be limited to, the following:

1. Type and brand of cement used
2. Design mix
3. Delivery tickets

1.4 CLASS OF CONCRETE

A. All concrete work on this Contract shall be Class A for the following items.

1. Concrete Cradle
2. Concrete Encasement
3. Manhole Bottoms
4. Concrete for Miscellaneous Uses
5. Concrete Curbing
6. Concrete Sidewalk
7. Thrust Blocks

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement shall be an acceptable brand of Portland Cement, ASTM C150, Type I. In the event field conditions require, and the Engineer finds it acceptable, a high-early strength Portland Cement, Type III may be used. Only one brand of cement shall be used in this work.

B. Water shall be clean, free from organic or vegetable matter, acid, alkali, or other injurious elements.

C. Fine Aggregate shall be clean hard natural sand or manufactured sand, or a combination of both and shall conform to ASTM C33.

D. Coarse Aggregate shall be hard, durable, uncoated crushed stone, gravel or air cooled blast-furnace slag conforming to ASTM C33. Maximum size of coarse aggregate shall not be larger than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, nor three-fourths of the minimum clear distance between reinforcing bars, whichever is least. In no case shall the maximum size exceed 1-1/2 inches.

E. All reinforcing bars shall conform to ASTM A615 Grade 60.

F. Wire for fabrication of the welded wire fabric shall conform to ASTM A82.

2.2 PROPORTIONING

A. Concrete mix shall have a consistency enabling it to be readily worked into all corners of the form and around all reinforcing by usual methods of placing and consolidating without permitting segregation or excessive free water.

B. All concrete on project shall be air-entrained, and the air content shall be 5% ± 1%.

C. Concrete mix shall be proportioned by an acceptable independent testing and/or inspection laboratory at the Contractor's expense. The design shall provide the following minimum 28 day compressive strengths:

1. Class A Concrete - 3000 psi

D. Regardless of the strengths shown by testing, all classifications of concrete shall have a maximum water cement ratio of 6 gallons per sack of cement, and a minimum cement factor of 5 sacks per cubic yard of concrete.

E. The slump of the concrete mix shall be 4 inches.

F. Concrete design mix shall be submitted to the Engineer for review before work commences. No concrete shall be placed until the Engineer has reviewed and accepted the design mix.

2.3 NON-SHRINK GROUT

A. Non-Shrink, Non-Metallic Grout shall be "Sika Grout 212" by Sika Corporation, Lyndhurst, NJ, or equal.

B. The epoxy compound shall be "Sikadur 32, Hi-Mod" by Sika Corporation, Lyndhurst, NJ.

2.4 GROUT

A. Grout shall be a Portland Cement Grout made from Type 2 cement, sand and 3/8 inch crushed stone plus a water reducer. Mix shall be designed for a 28 day strength of 4000 psi with a minimum cement content of 700 pounds per cubic yard, and a slump of four (4) inches.

B. Grout used for filling pipes to be abandoned shall be liquid and suitable for pumping into and filling the pipe to be abandoned.

PART 3 - INSTALLATION

3.1 DELIVERY OF CONCRETE

A. A delivery ticket shall be submitted with each batch at the time of delivery. Failure to render such ticket to the Contractor's Job Superintendent shall automatically be cause for rejection of the concrete. The delivery ticket shall show the following:

1. Amount of aggregate water
2. Amount of batch water
3. Quantities of sand, stone and cement
4. Design strength
5. Time that truck left batch plant

B. The Contractor's Job Superintendent shall write on the back of the delivery ticket:

1. The time of arrival of the truck mixer on the site
2. The time of deposit of the concrete from the truck
3. The place of deposit of the concrete

C. The completed delivery ticket shall be delivered to the Engineer. Failure to deliver such completed ticket to the Engineer will be cause for the Engineer to reject the deposited concrete at any time and cause it to be removed and replaced at the Contractor's expense.

D. No concrete shall be deposited on the job when it has contained its mix water longer than 60 minutes.

3.2 PLACING CONCRETE

A. Before placing concrete, all construction debris, water and ice shall be removed from the places to be occupied by the concrete.

B. Rock surfaces upon which concrete is to be placed shall be level, free from oil, water, mud, loose semi-detached or unsound rock fragments and rough enough to assure bond with concrete.

C. Where reinforcing bars are required, said bars shall be securely tied to prevent displacement during the pouring operation.

D. Concrete shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness to avoid flowing.

E. Falling concrete shall be closely confined in a drop chute of the proper size to within two or three feet of the place of deposit in the forms and the final drop must be vertical to avoid segregation of aggregates. In no case shall concrete be deposited from a height that will cause separation of the aggregates.

F. Concrete shall be mixed in such quantities as required for immediate use and shall be placed while fresh before loss of slump occurs. Re-tempering by adding water to restore slump lost during excessive mixing or due to too long a lapse of time since initial mixing will not be permitted.

G. All slabs shall be placed for full thickness in one operation without any change in proportions.

3.3 TEMPERATURE OF CONCRETE

A. Concrete, when deposited, shall have a temperature ranging between a minimum of 50 deg. F. and a maximum of 90 deg. F.

B. When the temperature of the surrounding air is below 40 deg. F. or above 90 deg. F., concreting shall be done in accordance with the recommendations noted in ACI-306 and ACI-305 respectively.

3.4 GROUTING

A. Grout shall be installed in accordance with ACI 302.

3.5 PROTECTION OF NEW WORK

A. All freshly placed concrete shall be adequately protected from mechanical injury or by action of the elements until such time as the concrete is thoroughly set.

3.6 CURING

A. Curing shall be started immediately upon completion of the finishing operation. Curing shall continue uninterrupted for a minimum period of 14 days unless a longer period is hereinafter specified. Rapid drying upon completion of the curing period shall be prevented. At no time during the curing period shall the temperature of the concrete be permitted to drop below 40 deg. F.

3.7 DEFECTIVE CONCRETE

A. Defective concrete is defined as concrete in place which does not conform to strength, shapes, alignments and/or elevations as shown on the Drawings.

B. All defective concrete shall be removed and replaced in a manner meeting with the Engineer's satisfaction.

END OF SECTION 32 3301

SECTION 33 2551 - SANITARY SEWERS AND APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE

A. Description of Work

1. Provide all labor, materials and equipment necessary to furnish and install all sanitary sewers and appurtenances as shown on the Drawings and specified herein.

2. The work consists of, but is not limited to, furnishing and installing pipe, materials for joint connections, house or building laterals to point indicated on Drawings, specials, fittings and appurtenances thereto.

B. Related Work Specified Elsewhere

1. Utility location, Shown on the Drawings.
2. Details, Shown on the Drawings.
3. Submittals, Section 01 3300, SUBMITTAL PROCEDURES.
4. Earthwork, Section 31 2220, EARTHWORK FOR UTILITIES.
5. Manholes, Section 33 2603, PRECAST UTILITY STRUCTURES.
6. Concrete, Section 32 3301 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

1.2 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings, cuts and/or samples of all materials to be used in the construction of the sewer lines. Submittals shall be in accordance with Section 01 3300, SUBMITTAL PROCEDURES.

B. Test Reports

1. Tests of pipe shall be made by the pipe manufacturer in accordance with requirements of ASTM and/or ANSI.

2. Certified copies of the tests made by the manufacturer, or by a reliable commercial laboratory acceptable to the Engineer, shall be submitted to the Engineer prior to the first shipment of pipe.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE

A. Pipe and Fittings

1. The polyvinyl chloride (PVC) pipe, 4 inches through 15 inches, shall be manufactured in accordance with ASTM D3034 "Specifications for Type PSM Poly (vinyl chloride) (PVC) sewer Pipe and Fittings" having a minimum wall thickness equal to SDR-35 (Standard Diameter Ratio) as noted in Table 1 of the ASTM Specification.

2. The pipe shall be "bell and spigot" type wherein the bell is integral to the pipe. For pipe with belled ends, the thickness of the wall in the bell may be considered satisfactory if the bell was formed on pipe meeting the requirements of the applicable standards.

B. Joints

1. The pipe and fittings shall be joined by the elastomeric gasket system conforming to ASTM D3212 "Specifications for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals."

2. The critical sealing dimensions of the bell, spigot and gasket shall be in accordance with the manufacturer's standard dimensions and tolerances.

3. The elastomeric gasket shall be rubber and shall comply with the physical requirements of ASTM F477 "Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe."

4. Field Joints: Fernco 1000 Series Couplers with Stainless Steel Shear Bands.

PART 3 - EXECUTION

3.1 HANDLING PVC PIPE

A. PVC sewer pipe and fittings may be stored either inside or outdoors. If it is stored outdoors for long periods, it shall be protected from direct exposure to sunlight.

B. PVC sewer pipe and fittings shall be stored in such a way so that the surfaces to be mated are protected from physical damage and are kept as clean as possible.

C. The pipe shall be stored by providing support at each end and intermediate support at 5-foot intervals along the length of the pipe. The pipe shall be stored in such a way as to prevent sagging or bending.

3.2 DEEP CUT LATERALS

A. Where required, deep cut laterals shall be constructed as per the details on the Drawings. All pipe shall conform to specifications. Care shall be taken to have all the joints perfectly made and the alignment correct. They shall be encased in Class "B" concrete to the required height. The concrete shall in all places cover the pipe for a depth of at least 5 inches.

3.3 PROTECTING AND KEEPING PIPE CLEAN

A. During construction, the mouth of the completed pipe shall always be kept properly closed with a suitable plug to prevent the entrance therein of any water, earth, stones or other debris. The Contractor shall also take any and all measures to keep the pipe clean and free from deposits and protect the pipe from damage.

B. If the pipe is damaged from any cause or becomes either partly or completely filled with dirt, stones, sand or other debris, the Contractor shall make all necessary repairs and remove at his own expense all such material. Upon refusal to do so, it will be done by the Owner and the cost thereof shall be charged as money paid to the Contractor.

3.4 PIPE LAYING

A. After the trench has been brought to the proper grade as heretofore specified, the pipe and specials shall be laid.

B. Care shall be taken to lay the pipe to true lines and grades. Every pipe laid shall be tested as to grade and alignment. Care must be taken to fit the joints together properly so that the centers of the pipes shall be in one and the same straight line, and so as to give an opening of even thickness, all around between spigot end of pipe and the socket end of specials and fittings. Each section of pipe shall rest upon the pipe bed for the full length of its barrel, with recesses excavated to accommodate bells and joints. Any pipe that has its grade or joints disturbed after laying, shall be taken up and re-laid. The interior of all pipe shall be thoroughly cleaned of all foreign matter, before being lowered into the trench, and shall be kept clean during laying operations by means of plugs or other approved methods. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions, or the weather, is unsuitable for such work. In all cases, water shall be kept out of the trench until the concrete cradle, where used, has hardened. Every precaution necessary to obtain watertight construction for all joints must be taken. This same precaution must be taken for all connections with manholes.

3.5 INSTALLING PVC PIPE

A. Joints

1. The joints shall be assembled in accordance with the manufacturer's recommended procedure.

2. Lubricants, if necessary for the assembly of the elastomeric gasket joint, shall not support bacterial growth nor have any deteriorating effect on pipe, fitting or gasket materials and shall be the type recommended by the pipe manufacturer.

B. Pipe Installation

1. Installation shall be made in accordance with ASTM D-2321, "Underground Installation of Flexible Thermoplastic Sewer Pipe".

2. Any field cutting and fitting of the PVC plastic sewer main shall be done in accordance with procedures and techniques specified by the pipe manufacturer.

3. The pipe and fittings shall be installed in accordance with Section 31 2220 - EARTHWORK FOR UTILITIES.

4. During the installation and backfill of the pipe, care must be taken to prevent movement of the pipe.

C. Couplings to Existing Pipes

1. Where feasible, the connection to an existing PVC pipe shall be by a gasketed pipe joint or fitting per paragraphs 2.1.A and 2.1.B of this section.

2. Connections to all other pipes shall be by installation of a Fernco Coupling with Stainless Steel Shear Rings. The coupling type shall be appropriate for the types of pipes being connected. The connection shall be at an existing pipe joint where feasible, or at a cleanly cut edge. The coupling shall also be an integral reducer should the pipes being joined be of different diameters.

3.6 TESTS

A. General

1. The Contractor, 60 days prior to the construction of Basin 6, or before, shall video tape the installed sewer laterals to the Fire Station Building, and provide the tapes to the Owner for review.

2. Any problems identified with the installed pipe, shall be resolved immediately by the Contractor.

B. The Contractor shall furnish all labor, electronic equipment and technicians to perform the closed circuit television inspection of the sewers. Operation of the equipment shall be controlled by a skilled technician from a control panel. The television studio shall be large enough to accommodate four (4) people for the purpose of viewing a monitor while the inspection is in progress. The Engineer and Owner shall have access to view the television screen at all times. At the completion of the Contract, the Contractor shall furnish to the Owner, a complete bound report of the video inspection.

END OF SECTION 33 2551

SECTION 33 2552 - WATER MAINS AND APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE

A. Description of Work

1. Provide all labor, materials and equipment necessary to furnish and lay all water mains and appurtenances, to lines and at depths indicated, as specified herein and/or shown on the Plans. Work shall include all excavation, furnishing and laying of mains and appurtenances, testing, backfill, compaction of same, rough and finish grading and replacement of all paving, curbs, gutters and sidewalks and all incidental work.

2. All work shall be laid to true line and grade and special care exercised where mains are laid along or under roads to secure adequate compaction of backfill to prevent any settlement of pavement.

B. Related Work Specified Elsewhere

1. Submittals, Section 01 3300, SUBMITTAL PROCEDURES.
2. Earthwork, Section 31 2220, EARTH FOR UTILITIES.
3. Testing/Disinfection, Section 33 2675, TESTING AND DISINFECTING WATER MAINS
4. Concrete, Section 32 3301, MISCELLANEOUS CAST-IN-PLACE CONCRETE.

1.2 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings, cuts and/or samples of all materials to be used in the construction of the water lines. Submittal shall be in accordance with Section 01 3300 SUBMITTAL PROCEDURES.

2. Certificates of conformance with specifications shall be submitted to Engineer for all material and equipment.

3. Submit tapping system including sleeve, valve and other materials proposed, and tapping assembly drawings with critical dimensions.

B. Test Reports

1. Tests of the ductile iron pipe shall be made by the pipe manufacturer in accordance with requirements of AWWA.

2. Certified copies of the tests made by the manufacturer, shall be submitted to the Engineer prior to the first shipment of pipe as follows:

   a. Hydrostatic Test
   b. Tensile Test
   c. Impact Test (70 deg. F) and low temperature impact tests (-40 deg. F)

3. Tests shall be conducted throughout manufacture of pipe.

PART 2 - PRODUCTS

2.1 PIPE

A. Ductile-Iron Pipe shall conform to "Ductile-Iron Pipe Centrifugally Cast In Metal Molds or Sand-Lined Molds, For Water or Other Liquids", ANSI A21.51, (AWWA C151), Thickness Class of the pipe shall be dependent upon size of pipe and depth of cover for laying condition Type "2", but must be a minimum of Class 52.

1. Joints shall be Push-On Joints except for fittings.

2. The rubber gaskets shall conform to the ANSI A21.11 (AWWA C111) for the mechanical and push-on joints.

3. Fittings shall be ductile iron, mechanical joint in accordance with ANSI A21.10 (AWWA C110). Push-on joints will not be acceptable for fittings. Mechanical joint compact fittings in accordance with AWWA C153 ANSI A21.53 are acceptable.

4. All pipe and fittings shall be coated on the outside with a bituminous coating in accordance with ANSI A21.51 (AWWA C151). The pipe and fittings shall have a double cement lining in accordance with ANSI A21.4 (AWWA C104).

5. Mechanical joint retainer glands shall be in accordance with ANSI A21.11 (AWWA C111). Retainer glands shall be "MEGALUG" as manufactured by Ebba Iron Co. and shall be provided at all fittings.

6. “Field LOK 350 Gaskets” as manufactured by U. S. Pipe or equal, shall be provided as needed on straight runs of pipe for additional restraining capabilities.

B. Copper Pipe for house connections shall be seamless copper tubing, Type K heavy wall, soft temper, ASTM B88. Provide in maximum unbroken lengths. All services shall be continuous pieces of pipe with no splicing. All underground joints shall be compression connections.

2.2 VALVES

A. Gate Valves shall be resilient seat, non-rising stem, O-ring stem seal and 250 psi working pressure with mechanical joint ends. Valves shall be nut operated and open LEFT (counter clockwise). All valves shall be installed vertically. They shall be manufactured by U S Pipe Company, Mueller, or equal. No horizontal valves are to be installed.

B. Valve Boxes shall be adjustable two-piece, cast iron screw type of adequate extension for depth and of suitable base for particular valve, as manufactured by Bingham & Tyler (Fig. 4905) or equal and shall be the sizes shown on the Plans.

2.3 METERS AND METER PITS

A. Meter Pit shall be constructed as specified on Drawing 148.6.

B. Double Check Valve Backflow Preventer

1. Shall conform to the requirements of AWWA C510 for potable water

2. Shall have full ported test cocks for testing

3. Shall maintain a minimum of one PSI across the valve during normal flow operation

4. Acceptable manufacturers include:

a. Watts Regulator Co. – Series 709
b. Conbraco Industries – Series 40-100
c. Hersey Products – Model FDC or N2
d. or approved equal

C. Detector Check Valve

1. Shall conform to the requirements of AWWA C511

2. Shall have fully ported test cocks for testing.

3. Shall maintain a minimum of two PSI across the valve during normal flow operation.

4. Acceptable manufacturers include:

a. Watts Regulator Co. – Series 990 or 009
b. Conbraco Industries – Series 40-200
c. Hersey Products – Model FRP11 or 6CM
d. or approved equal

D. Gate Valve

1. Shall conform to the requirements of AWWA C515 (OS&Y)

2. Gate valves shall be of type resilient wedge with rising stem, flanged ends, and be hand wheel operated

3. Acceptable manufacturers include:

   a. Kennedy
   b. Clow-O
   c. or approved equal

E. Check Valves

1. Shall conform to the requirements of AWWA C508

2. Valves shall be of type full-body swing check valve with Buna-N soft seats

3. All check valves shall have an unobstructed flow path when open.

4. Acceptable manufacturers include:

   a. Stayflow Strainers and Valves
   b. APCO
   c. or approved equal

F. Meter

1. 6" Meter shall be 6" Sensus OMNI F2, Fireline, Fire Service Meter Assembly or approved equal

2. 3" Meter shall be 3" Sensus OMNI C2 Meter or approved equal.

PART 3 - EXECUTION

3.1 TRENCHES

A. Trenches for the water mains shall be constructed in accordance with Section 31 2220, EARTHWORK FOR UTILITIES.

3.2 LAYING PIPE

A. Pipe and fittings shall be carefully handled and lowered into trench. Ends of pipe shall abut against each other in such manner that there shall be no shoulder or unevenness on the inside of main. In no case shall the water main have a cover of less than four feet, unless otherwise noted on the Drawings.

B. Special care shall be taken to insure that the pipes are well bedded on a solid foundation, and any defects due to settlement shall be made good by Contractor at his own expense. Bell holes shall be dug sufficiently large to insure making of proper joints. Special precautions shall be exercised to prevent any pipe from resting on rock.

C. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipes and fittings shall be used. Great care shall be taken to prevent pipe lining and coating from being damaged and any lining or coating damaged in any way shall be repaired by Contractor.

D. Pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until acceptance of completed work. Each length of pipe on fitting in water mains shall, just before being lowered into trench, be placed on blocks or other supports and the whole internal surface well swabbed out with a solution of chloride of lime in proportion of three (3) ounces per gallon of water by means of a mop mounted on a long handle.

E. Solution shall be made up fresh daily and any left over at end of day shall be wasted. Pipe or fitting, after being thoroughly swabbed out shall then be carefully lowered into trench so as to exclude dirt and other foreign substances, and after it has been "homed", end shall be kept closed with a tight stopper until next length is laid. At close of work each day end of pipe line shall be tightly closed with an expansion stopper so that no dirt or other foreign substance may enter line, and this stopper shall be kept in place until pipe laying is again resumed.

F. Whenever a pipe requires cutting to fit in line or to bring it to required location, work shall be done in satisfactory manner so as to leave a smooth end, and without extra compensation.

G. No springing of bell and spigot joints to effect a change in direction will be allowed.

3.3 SETTING VALVE BOXES

A. When setting a valve box in place, it shall be installed in accordance with the manufacturer's recommendations. Valve boxes shall be installed to allow ample space around the valve to permit free access to the valve with a valve wrench or a valve truck.

3.4 JOINTS

A. All joints shall be made with specified joint, installed in strict accord with manufacturer's instructions by workmen skilled in this type of work.

3.5 JOINT RESTRAINTS

A. General

1. Joint restraints shall be made as specified herein.

2. The restraints shall be as follows:

a. Thrust blocks
b. Mechanical joint retainer gland
c. Restrained joint gaskets (field LOK350 Gaskets)

B. Thrust Blocks

1. The pipe, fittings, and valves shall be secured in place by suitable concrete foundation or thrust blocks as detailed in the Construction Details and as directed by the engineer.

C. Restrainer Glands & Pipe Restraints

1. General

a. All bends and fittings shall be mechanical joint restrained with retainer glands.
b. All pipe joints located within 36 feet of all fittings and changes of alignment shall be restrained with restrained joint gaskets.

2. Installation

a. Pipe restraints shall be installed in accordance with the manufacturer's recommendations.

3.6 CONNECTIONS

A. Connections to existing work will be made by Contractor at such a time and in such manner as Engineer may require and this cost shall be borne by Contractor. The Connections to existing work may require work on weekends, holidays, or night work. Upon notification by the Owner's representative, the consumers in the area to be affected by the shut-off shall be notified by the Contractor and all valves necessary for this operation will be operated by the Owner's representative or under his direction. Contractor shall complete connections with greatest possible speed, so that the public will be inconvenienced as little as possible. Should it be necessary, Contractor will be required to make connections at night, but he will be allowed no extra compensation for such work. Where necessary to remove existing work in order to make connections, such work shall be done by Contractor without any additional compensation.

3.7 BLOCKING

A. In setting pipe, fittings, etc., such blocking and wedges as may be required shall be used. Blocking and wedges shall be of such material and dimensions as may be necessary to support pipe, fittings, etc., properly. Blocking shall be placed immediately back of each bell before the joint is made. All valves shall be supported as indicated or as specified by Engineer.

3.8 PIPE TAPPING

A. The tapping activities shall be completed at each stage of pipe replacement work as required for the efficient progress of piping work.

B. After completion of each tap, install a permanent concrete support cradle, or other support as required and as approved by the Engineer, beneath the gate valve.

C. Screw corporation stops directly into a tapped and threaded iron main at 10 or 2 o'clock positions on the main's circumference. Locate corporation stop at least 12" apart longitudinally and staggered. A double wrap of three (3) mil Teflon tape shall be placed on each corporation stop.

3.9 DEFECTIVE WORK

A. Any defective work shall be replaced or repaired by Contractor at his own expense. Any leaks occurring after conditional acceptance but before final acceptance due to either blown joints or cracked pipe or fittings, shall be repaired by Contractor at his own expense. When pipe or fittings are damaged in any respect they shall be replaced by new at expense of the Contractor. If any of the above repair work is done by the Owner the actual cost of replacing such materials and making such installations will be deducted from any amount of money retained by Owner.

PART 4 - DISINFECTION AND TESTING

4.1 TESTING

A. The water main and appurtenances installed under this Section of the Specifications shall be tested in accordance with ANSI/AWWA C600 (latest issue) "Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances", "Hydrostatic Testing." (Refer to Specification Section 33 2675 – TESTING & DISINFECTING WATER MAINS).

B. The system working pressure at the point of testing is 80 psi.

4.2 DISINFECTION

A. Upon completion of the newly installed water system and appurtenances under this Section and after the system has satisfactorily passed the pressure test, including all necessary repairs, the pipe shall be disinfected according to the instructions listed in in Specification Section 33 2675, TESTING & DISINFECTING WATER MAINS.

END OF SECTION 33 2552

SECTION 33 2603 - PRECAST UTILITY STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast Concrete Meter Chamber

B. Storm Drainage Inlets and Endwalls

C. Inlet Grates

D. Access Doors

E. Access Steps

1.2 RELATED SECTIONS

A. Section 01 3300 – Submittal Procedures

B. Section 31 2200 - Site Excavation and Earthwork

C. Section 31 2220 - Earthwork for Utilities

D. Section 32 2575 - Paving and Resurfacing

E. Section 33 2720 - Storm Sewer Pipe

1.3 REFERENCES

A. PennDOT Construction Specifications Publication 408.

B. American Society for Testing and Materials (ASTM):

A48 Specification for Gray Iron Castings
C32 Specification for Sewer and Manhole Brick
C270 Specifications for Mortar for Unit Masonry
C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
C858 Specifications for Underground Precast Concrete Utility Structures
C891 Installation of Underground Precast Concrete Utility Structures
C913 Specification for Precast Concrete Water and Wastewater Structures
C923 Specification for Resilient Connections between Reinforced Concrete Manhole Structures and Pipes

1.4 SUBMITTALS

A. Certificates:

1. Submit certifications from material suppliers attesting that materials meet or exceed specification requirements.

B. Shop Drawings:

1. Submit detail shop drawings of precast utility structures and components.

2. Submit manufacturers' descriptive literature for flexible connections to the utility structure.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling:

1. Do not place materials on private property without written permission of the property owner.

2. During loading, transporting and unloading, exercise care to prevent damage to precast reinforced concrete utility structure components and other products specified herein. Avoid shock or damage at all times.

3. Through-wall lifting holes are not permitted in precast reinforced concrete utility structure component construction.

B. Storage:

1. Store precast reinforced concrete utility structure components and other products specified herein in accordance with the manufacturer's recommendations to prevent joint damage and contamination.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

A. Crushed Stone Subbase: PennDOT 2B, Section 703.2, Publication 408 Specifications. Minimum 6" required under base.

B. Masonry Mortar: ASTM C270, Type S.

C. Joint Sealant Compound: in accordance with Federal Specification FS SS-S-00210, preformed, flexible, self-adhering, cold-applied.

D. Rubber Gaskets: ASTM C443.

E. Resilient Pipe Connection: ASTM C923.

1. Acceptable Manufacturers:

a. A-LOK Products, Inc.
b. Substitutions in accordance with Section 01 2500 Substitution Procedures.

2.2 PRECAST CONCRETE UTILITY STRUCTURES:

A. ASTM C858

B. 5.5% ± 1% air-entrained cement concrete.

C. Steel reinforcement shall be epoxy coated.

D. Concrete shall be a minimum of 3,000 psi.

E. Through-wall lifting holes shall not be permitted in precast concrete utility structure construction. Lifting keys or lugs shall be factory-installed in structure components.

2.3 METER PITS, INLETS, AND ENDWALLS

A. All storm sewer structures (unless approved by the Township) shall be precast reinforced concrete.

B. All precast concrete storm sewer structures shall be supplied by a pre approved PennDOT supplier.

C. All precast concrete storm sewer structures shall comply with PennDOT Publication 408 Specifications.

D. All inlets and meter pits four feet (4') or deeper (from top of grate or access door) shall have access steps installed.

2.4 INLET GRATES

A. Design for H 20 loading.

B. All grates shall be bicycle safe unless otherwise approved by the ENGINEER.

2.5 ACCESS DOORS

A. Door shall be ¼" aluminum diamond plate designed for H 20 loading requirements manufactured by BILCO Model JD-2A-H2O or approved equal.

B. Channel frame shall be ¼" with a minimum cross section of 7 sq. in.

C. A continuous gasket shall be mechanically attached to the frame to create a dirt and debris barrier for the channel frame.

D. Door shall be equipped with stainless steel compression springs for easy opening; a hold-open arm with a release handle; stainless steel slam lock with nylon threaded cover plug and removable turn/lift handle; and stainless steel hinges and pins.

E. A 1½" drainage coupling with a drain pipe discharging to the surface shall be provided for draining the channel frame.

F. Factory finish with bituminous coating on exterior surfaces in contact with concrete.

G. Access doors shall come equipped with grating safety panel(s), painted safety yellow, to provide for fall protection. Panel shall be designed to meet the requirements of OSHA standard 29 CFR 1910.23 and be equipped with a hold open device to lock the grating panel(s) in the open position. Hold open device and all hardware shall be Type 316 stainless steel.

H. Manufacturer shall guarantee against defects in materials and workmanship for a period of ten (10) years.

I. Acceptable Manufacturers:

a. The BILCO Company
b. U.S.F. Fabrication, Inc.
c. Substitutions in accordance with Section 01 2500.

2.6 ACCESS STEPS

A. Polypropylene or fiberglass coated steel with suitable protective coating on portions embedded in concrete.

1. Acceptable Manufacturers:

a. M.A. Industries, Inc. - Stock No. PS-1
b. Alcoa Aluminum Alloy Part No. 30105
c. Utility Products, Inc. - Perma-Step 100-2
d. Substitutions in accordance with Section 01 2500.

B. Aluminum with suitable protective coating on portions embedded in concrete.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Perform excavation to the line and grade shown on the Contract Drawings.

B. Location and depth of utility structures as shown on the Drawings.

3.2 CONSTRUCTION

A. Construct utility structures of precast concrete.

B. Install a minimum of 6" of crushed stone subbase.

C. Install precast utility structures as shown on the Drawings.

1. Set the precast utility structure on 6” minimum crushed stone subbase.

2. Provide a sealed, flexible resilient connection between pipe and precast utility structure.

D. Seal joints, if any, between precast concrete utility structure segments with preformed rubber gaskets or joint sealant compound.

1. Place joint sealant compound on both ledges of the lower section to be squeezed by the weight of the upper section.

2. Place rubber gasket in groove formed in spigot end. Equalize gasket tension.

E. Install utility structure sections with steps in proper vertical alignment.

F. Install concrete pipe supports as shown on Drawings.

G. All pipe connections into endwalls, inlets and junction boxes shall be professionally sealed using masonry “pop corn” brick with non shrink mortar. The outside joint shall be properly parged with the mortar mix and allowed to set prior to completing backfill. No red brick or field stone may be used.

H. When inlets are to be tied into new or existing curb, the inlet shall have an opening on the two foot (2’) end of the structure to accommodate a six inch (6”) plastic under drain pipe. The invert of the opening shall be at least twenty eight inches (28”) from top of curb. The six inch (6”) underdrain pipe shall extend out from the inlet and under the subbase for the curb. The end of the underdrain pipe (beneath the curb) shall be capped with 1/8” mesh screening or other plug approved by the ENGINEER.

I. All precast inlet tops (C, M and S) shall be set to finished grade elevation by use of reinforced concrete riser blocks.

J. All precast structures shall be backfilled with 2A aggregate placed in well compacted eight inch (8”) lifts using a gas powered jumping jack. No other means of compaction is acceptable unless approved by the ENGINEER.

3.3 BACKFILLING

A. Backfill only after examination of the structure by the ENGINEER.

B. Perform backfilling as specified in Section 31 2220.

END OF SECTION 33 2603

SECTION 33 2675 - TESTING AND DISINFECTING WATER MAINS

PART 1 - GENERAL

1.1 1.01 SECTION INCLUDES

A. Testing Water Main Pipeline:

1. Hydrostatic pressure testing

2. Leakage testing

B. Disinfecting:

1. Bacteriological testing

1.2 RELATED SECTIONS AND REFERENCES

A. Section 33 2552: WATER MAINS AND APPURTENANCES

B. American Water Works Association (AWWA):

C600 Standard for Installation of Ductile Iron Water Mains and Appurtenances, Section 4
C651 Standard for Disinfecting Water Mains

1.3 QUALITY ASSURANCE

A. Testing Agency:

1. Bacteriological testing shall be performed by a testing laboratory engaged and paid for by the CONTRACTOR and approved by the ENGINEER.

B. Test Acceptance:

1. No test will be accepted until the results are below the specified maximum limits.

2. The CONTRACTOR shall, at his own expense, determine and correct the sources of leakage and retest until successful test results are achieved.

1.4 SUBMITTALS

A. Test Procedures: Submit a testing sequence schedule including a list of testing equipment to be used.

B. Certificates:

1. Submit, prior to starting testing, an electronic copy of the certification, attesting that the pressure gauges to be used have been calibrated and are accurate to the degree specified in Part 2, Products.

2. Submit an electronic copy of the certification attesting that the chlorine form composition is as specified.

C. Test Reports: Submit an electronic copy of laboratory test reports of each bacteriological test.

PART 2 - PRODUCTS

2.1 HYDROSTATIC TEST EQUIPMENT

A. Minimum Equipment Required

1. Hydro pump
2. Pressure hose
3. Test connections
4. Water meter
5. Pressure gauge, calibrated to 0.1 lbs./sq. in.
6. Pressure relief valve

2.2 DISINFECTING CHEMICALS

A. Liquid chlorine, calcium hypochlorite, or sodium hypochlorite conforming to AWWA Standards B300 and B301.

PART 3 - EXECUTION

3.1 PREPARATION

A. Backfill trenches in accordance with Section 31 2220.

B. Provide the water line under test with reaction thrust blocking. Hydrostatic testing shall not begin until the concrete thrust blocking has set, but not before a minimum of 7 days after pouring.

C. Provide pumps, piping, tanks, connections, polyurethane plugs, and appurtenances. The OWNER will provide the necessary water for one (1) fitting of the line(s) to be tested at no cost to the CONTRACTOR. Retest volumes, if required, will be charged to the CONTRACTOR.

3.2 TESTING WATER LINES

A. Hydrostatic Testing:

1. Test each newly installed section of water line by hydrostatic test procedure in accordance with the recommended practice established by AWWA, Standard C600, Section 4.

2. Conduct pressure tests for a period of not less four (4) hours at a pressure of not less than 1.5 times the working pressure based upon the elevation of the lowest point in line under test corrected to the elevation of the test gauge, or 150 psi, whichever is more. Obtain test pressure from the ENGINEER.

3. Slowly fill the section to be tested with water, expelling air from the pipeline at the high points. Install corporation stops at high points if necessary. After all air is expelled, close air vents and corporation stops and raise the pressure to the specified test pressure.

4. Observe joints, fittings and valves under test. Remove and replace cracked pipe, joints, fittings, and valves showing visible leakage.

5. Retest as necessary.

B. Leakage Tests

1. In conjunction with the Hydrostatic test, conduct the leakage test for a 4-hour period at the test pressure indicated above. Maximum allowable leakage shall be ten (10) gallons per day per inch of pipe diameter per mile of pipe.

2. Expel air from the line under test, close the air vents and/or corporation stops and raise pressure to the specified test pressure. The leakage in the section under test is defined as the quantity of water supplied to maintain pressure within 5 psig of the specified test pressure during the entire testing period. Water pipe installation is deemed to have failed the leakage test, if the leakage obtained is greater than that determined by the formula:

$$L = \frac{N * D * P^{½}}{7400}$$

Where:

L is allowable leakage in gallons/hour
N is number of joints in the section tested
D is nominal diameter of pipe in inches
P is average test pressure in pounds per square inch gauge
7400 is a conversion factor constant

3. If the line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.

4. If test results indicate that the pipe laid has leakage greater than specified, locate and repair the defective joints, fittings, pipe or valves and retest until leakage is within allowable limits. Repair visible leaks regardless of the amount of leakage.

3.3 DISINFECTION

A. General:

1. After completion of satisfactory pressure and leakage testing, disinfect the water pipelines in accordance with the recommended practice established in AWWA Standard C651. Conduct water line disinfection under the direct observation of Shillington Municipal Authority and/or Western Berks Water Authority in the following steps:

   a. Preliminary flushing
   b. Chlorine application
   c. Final flushing
   d. Bacteriologic tests

B. Preliminary Flushing:

1. Prior to disinfection, except when the tablet method is used, fill the line to eliminate air pockets and flush the line at a rate of flow of 2.5 feet per second to remove particulates. Refer to AWWA C651 for rate of flow to produce 2.5 fps in pipe of various sizes.

2. Dispose of flushing water in compliance with Federal, State and Local laws.

C. Chlorine Application:

1. Chlorine Form:

   a. The chlorine form to be applied to the system shall be either chlorine gas solution, calcium hypochlorite or sodium hypochlorite. The ENGINEER's written approval of the chlorine form to be used is required.

   b. Chemical Quantities:
   For each one hundred (100) feet of pipe, when gas or calcium hypochlorite is used, or for each eighteen (18) foot section when tablets are used, the following quantities of chemicals should be applied for the respective pipe sizes noted:

Size, Inches	Lbs. Cl2 gas	No., Tablets Ca(OCl)2
4	0.013	1
6	0.030	1
8	0.054	2
10	0.085	3
12	0.120	4
16	0.217	6

2. Continuous Feed Method:

    a. During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 ft. intervals. Refer to AWWA C651 for quantity of granule to be used.

        WARNING: This procedure must not be used on solvent welded plastic pipe or in screwed joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

    b. The continuous feed method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to remove air pockets, flushing to remove particulates, and filling the main with potable water chlorinated so that after a 24-hour holding period in the main there will be a free chlorine residual of not less than 10 mg/L.

    c. Feed water and chlorine to the line at a constant rate such that the water will have not less than 25 mg/L free chlorine.

        Chlorine application shall not cease until the entire line is filled with heavily chlorinated water.

    d. During chlorine application, take precautionary measures to prevent the concentrated treatment solution from flowing back into the existing distribution system and/or supply source.

3. Tablet Method:

    a. During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 ft. intervals. Refer to AWWA C651 for quantity of granule to be used.

        WARNING: This procedure must not be used on solvent welded plastic pipe or in screwed joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

    b. The tablet method consists of placing tablets in the water main as it is being installed and then filling the main with potable water when installation is completed.

        NOTE: Since the preliminary flushing step must be eliminated, this method may be used only when scrupulous cleanliness has been exercised and only with approval of the ENGINEER. It shall not be used if trench water or foreign material has entered the main, or if the water temperature is below 41°F.

c. During construction, place sufficient number of 5g calcium hypochlorite tablets in each section of pipe, in hydrants, hydrant branches, and other appurtenances to obtain a minimum of 25 mg/L available chlorine. Attach tablets to the crown of pipe sections with adhesive approved by USDA. Apply adhesive only to the broad side of the tablet next to the pipe surface. Refer to AWWA C651 for the proper number of 5g calcium hypochlorite tablets required.

d. When pipeline installation is completed, fill the main with water at a maximum velocity of one foot per second. This water shall remain in the pipe for at least 24-hours. Manipulate valves so that the chlorine solution does not flow back into the line supplying the water.

4. During the 24-hour treatment, operate all valves, curb stops, and hydrants in the section treated.

5. At the completion of the 24-hour treatment, the treated water in all portions of the main shall have a residual of not less than 5 mg/L free chlorine.

6. Repeat the disinfection process until the minimum available chlorine is present at the end of the treatment sequence. The tablet method cannot be used in these subsequent disinfections.

D. Final Flushing:

1. Flush the heavily chlorinated water from the system under treatment until the chlorine concentration in the water leaving the system is no higher than that generally prevailing in the system or is acceptable for domestic use.

2. Comply with Federal, State and local laws when discharging the flushed chlorine solution.

E. Bacteriological Testing (To be completed by Shillington Municipal Authority and/or Western Berks Water Authority):

1. After final flushing is completed and before the water main is placed in service, test the line for bacteriologic quality. Perform two tests 24-hours apart.

2. Collect a minimum of one sample at the end of each line for each test, and one sample of the incoming water from the existing water system for comparison.

3. Collect samples in sterile bottles treated with sodium thiosulphate.

4. Sampling tap shall consist of corporation stop installed in the main with copper tube gooseneck assembly. No hose or fire hydrant shall be used to collect samples.

5. Provide bacteriological test reports to the OWNER and the ENGINEER. Failure to meet Federal, State and Local standard requirements will be cause for the CONTRACTOR to rechlorinate and retest the system.

3.4 COMBINED TESTING

Where approved in advance by the ENGINEER, the hydrostatic test, leakage test, and disinfection procedures may be coordinated so that the tests and disinfection procedures are concurrently accomplished.

END OF SECTION 33 2675

SECTION 33 2720 - STORM SEWER PIPE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Work of this Section Includes, but is not limited to:

1. Storm sewer pipelines

2. Underdrains

1.2 RELATED SECTIONS

A. Section 31 2220: Earthwork for Utilities

B. Section 33 2603: Precast Utility Structures

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe, Type C or CP, 75 to 250 mm (3 to 10 inches) diameter

2. AASHTO M294 – Specification for Corrugated Polyethylene Pipe, 305- to 915-mm (12 inches to 36 inches) diameter.

3. AASHTO T99 – Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb.) Rammer and a 305 mm (12 inches) Drop.

4. AASHTO T180 – Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 inch) Drop.

B. ASTM International Referenced Standards:

1. ASTM D 2321, Standard practice for underground installation of thermoplastic pipe.

2. ASTM D 3212, Standard Specifications for joints for drain and sewer plastic pipe using flexible elastomeric joints.

3. ASTM F 4794, Elastomeric seals (Gaskets) for joining plastic pipe.

4. ASTM F 667, Standard Specifications for large diameter corrugated polyethylene pipe and fittings.

5. ASTM C14 – Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

6. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

7. ASTM C443 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

8. ASTM C506 – Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.

9. ASTM C507 – Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

10. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft3 (600 kN-M/M3)).

11. ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).

12. ASTM D2922 – Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear methods (Shallow Depth).

13. ASTM D3017 – Standard Test Method for Water Content of Soil and Rock in Place by Nuclear methods (Shallow Depth).

14. PennDOT Standards, Publication 408, Latest Edition, Section 601.

1.4 SUBMITTALS

A. Certificates: Submit manufacturer's certification attesting that the pipe, fittings and joints meet or exceed specification requirements.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting and unloading, exercise care to prevent damage to materials.

B. Do not drop pipe or fittings. Avoid shock or damage at all times.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE) AND SLCPP PIPE

A. All HDPE storm and culvert pipe shall conform to the requirements of PennDOT Publication 408 Specifications, Section 601 – Pipe Culverts, latest edition.

B. All pipe shall be SLCPP, Smooth Lined Corrugated Polyethylene Pipe.

C. The pipe shall have a bell and spigot type joint using a gasket providing either “soil tight” or “water tight” gasketed joints.

1. Soil tight per ADS N-12 ST IB pipe meeting requirements of AASHTO M294, Type S or SP, or ASTM 2306.

2. Water tight per ADS N-12 WT IB pipe meeting requirements of AASHTO M294 Type S, or ASTM F2306. Joints shall meet watertight requirements of ASTM D3212 with gaskets meeting requirements of ASTM F477.

D. In areas having limestone and/or other carbonate soils with a possibility for sinkholes, the “water tight” gasket meeting the requirements of ASTM D3212 shall be utilized.

E. Acceptable Manufacturers:

1. ADS

2. Substitutions in accordance with Section 01 3300.

2.2 REINFORCED CONCRETE PIPE (RCP)

A. Pipe and Fittings:

1. ASTM C76, Minimum Class V

2. PennDOT 408, Section 601

B. Joints:

1. Bell and spigot with water tight rubber O-ring gasket.

2. O rings and rubber gasket shall conform to requirements of ASTM C 361.

3. The bottom half of each pipe joint shall be mortared on the inside of the pipe.

4. Plug lift hole with manufactured plastic plug (no field stone or mortar may be used).

2.3 ACCESSORIES

A. Geotextile Fabric in accordance with PennDOT Publication 408. Specifications, latest edition.

B. Filter Sock shall conform to requirements of ASTM D6707.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform trench excavation to the line and grade shown on the Contract Documents and as specified in Section 31 2220 and as noted on the Drawings.

B. Provide pipe bedding as specified in Section 31 2220 and as noted on Drawings for each type of pipe used. Place aggregate in a manner to avoid segregation, and compact to the maximum practical density so that the pipe can be laid to the required tolerances.

3.2 LAYING PIPE IN TRENCHES

A. Give ample notice to the ENGINEER in advance of pipe laying operations.

B. Lower pipe into trench using handling equipment designed for the purpose to assure safety of personnel and to avoid damage to pipe. Do not drop pipe.

C. Lay pipe proceeding upgrade with the bell or groove pointing upstream.

D. Lay pipe to a true uniform line with the barrel of the pipe resting solidly in bedding material throughout its length. Excavate recesses in bedding material to accommodate joints, fittings, and appurtenances.

E. Lay each section of pipe to form a close concentric joint with the adjoining section and to avoid offsets in the flow line.

F. Clean and inspect each pipe and fitting before joining. Align pipe with previously-laid sections. Assemble to provide tight, flexible joints that permit movement caused by expansion, contraction, and ground movement. Assemble joints in accordance with the pipe manufacturer's instructions.

G. Check each pipe installed as to line and grade in place. Correct deviation from line and grade immediately. A deviation from the designed grade as shown on the Contract Documents, or deflection of pipe joints, will be causes for rejection.

H. Plug the lift hole in reinforced concrete pipe with a manufactured plastic plug. The use of field stone or mortar to plug the lift hole will not be acceptable.

I. Place and compact sufficient backfill to hold each section of pipe firmly in place as the pipe is laid.

3.3 BACKFILLING TRENCHES

A. Backfill pipeline trenches only after examination of pipe laying by the ENGINEER.

B. Backfill and compact trenches as specified in Section 31 2220 and as noted on the Drawings.

END OF SECTION 33 2720