



**MUNICIPAL BUILDING
&
POLICE STATION**

**LOWER POTTS GROVE TOWNSHIP
MONTGOMERY COUNTY**

MG Project #23-0047.0

September 3, 2024

LOWER POTTS GROVE TOWNSHIP
MUNICIPAL BUILDING & POLICE STATION

1963 East High Street
Pottstown, Montgomery County, Pennsylvania

owner

LOWER POTTS GROVE TOWNSHIP
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owner's agent

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MG PROJECT No. 23-0047.0

September 3, 2024

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END OF SCHEDULE OF DRAWINGS

DOCUMENT 001113 - ADVERTISEMENT FOR BIDS

PROJECT NUMBER: MGA #23-0047.0

Project Name: Lower Pottsgrove Township Municipal Building & Police Station

Project Address: 1963 E High Street, Pottstown, Pennsylvania 19464

-for-

Lower Pottsgrove Township, Montgomery County, Pennsylvania

Lower Pottsgrove Township will receive sealed Bids for the separate Prime Contracts of General Construction, HVAC Construction, Plumbing Construction, and Electrical Construction, for the Lower Pottsgrove Township Municipal Building & Police Station renovation project. Bid each contract on a lump sum basis; segregated Bids will not be accepted.

The Board will receive Bids via PennBid until the time and date scheduled below. Bids received after this time will not be accepted. Bids will be publicly disclosed on the PennBid platform after review by the Owner and Architect.

PRE-BID CONFERENCE DATE/TIME:	Wednesday, September 18, 2024 at 9:00 A.M. in 1963 East High Street, Pottstown, PA 19464
BID DUE DATE:	Friday, October 4, 2024
TIME OF RECEIPT:	2:00 PM
PLACE OF RECEIPT:	PennBid
BID SECURITY	10% of Base Bid

Online and Printed Procurement and Contract Documents: Contract documents are available for review and purchase, at bidder's expense, via PennBid.

Paper copies of Plans and Specifications may be obtained as complete documents at bidder's nonrefundable expense from the Architect. They may be picked up from the Architect's office at 1268 Penn Ave., Wyomissing, PA 19610 or mailed at the bidder's expense.

Prior to contract award and execution, the successful bidder is required to comply with the Public Works Employment Verification Act 43 P.S. §§ 167.1-167.11. Successful bidder must complete and submit a Public Works Employment Verification Form to Lower Pottsgrove Township. Forms may be obtained online at: www.dgs.state.pa.us.

A pre-bid conference will be held on the date and at the time listed on page 001113-1. Bidders will meet at **9:00 A.M. at the project site located at 1963 East High Street, Pottstown, PA 19464**. After the pre-bid conference, Bidders will be permitted to examine the areas of the Work. Additional site visits shall be limited to the following times and require pre-registration with the Owner's Agent prior to 5:00 P.M. the day prior to the planned visits.

Site Visitations shall be permitted during the following:

Wednesday, September 25, 2024; 1:00 P.M. to 4:00 P.M.
Thursday, September 26, 2024; 9:00 A.M. to 12:00 P.M.

The Bidder shall submit a properly executed AIA Document A305, Contractor's Qualification Statement, a sample of which is included in the Project Manual, and a supplemental Qualified Contractor Certification form to be completed by each Prime Contractor and its major Subcontractors.

The Owner reserves the right to waive irregularities and to reject bids.

The Contracts shall be subject to the Pennsylvania Prevailing Wage Act.

Questions pertaining to the content of the Bidding Documents shall be directed to Scott O Graham, AIA via the PennBid portal.

By order of the Board of Commissioners
Lower Pottsgrove Township

END OF DOCUMENT 001113

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: Lower Pottsgrove Township Municipal Building & Police Station.
 - 1. Project Location: 1963 E High Street, Pottstown, PA 19464.
- C. Owner:
 - 1. Lower Pottsgrove Township, Montgomery County, Pennsylvania
 - 2. Edward Wagner, MPA, Township Manager
 - 3. 2199 Buchert Road, Pottstown, PA 19464.
 - 4. 610.323.0436
 - 5. EWagner@lowerpottsgrove.org
- D. Owner's Agent:
 - 1. Providence Consulting Associates, LLC.
 - 2. Christopher Caggiano, President
 - 3. 772 Borough Line Road, Collegeville, PA 19426.
 - 4. 610.310.1759
 - 5. CCaggiano1@gmail.com
- E. Architect:
 - 1. MG Architects, Ltd.
 - 2. Scott O. Graham, AIA, LEED AP BD+C, Principal.
 - 3. 1268 Penn Avenue, Wyomissing, PA 19610.
 - 4. 610.376.4927
 - 5. ScottG@MG-Architects.com
- F. Project Description: Level 3 renovations for the adaptive re-use/conversion of the former Tower Health Facility to new offices and police station for the Township of Lower Pottsgrove, Montgomery County, Pennsylvania. The scope shall include spatial reconfiguration of most interior areas, building-wide fenestration replacement and replacement of the building HVAC, Electric and Plumbing systems. The existing sprinkler system shall remain, but be modified to the new interior layout. The work shall include the construction of a one-story, 2,000 sf garage/storage addition to the north side of the building and associated site renovations.

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

1. Multiple Contract Project consisting of the following prime contracts:
 - a. General Construction.
 - b. Plumbing Construction.
 - c. Mechanical Construction.
 - d. Electrical Construction.

1.2 BID SUBMITTAL AND OPENING

- A. Owner will receive bids via PennBid until the bid time and date indicated below. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:

1. Bid Date: Friday, October 4, 2024
2. Bid Time: 2:00 p.m. local time.
3. Location: PennBid.

- B. Bids will be reviewed by Owner and Architect, and then disclosed publicly via PennBid.

1.3 BID SECURITY

- A. Bid security shall be submitted with each bid in the amount of 10 percent of the bid amount.
- B. Each bid must be accompanied by a proposal guaranty, a certified check, bank cashier's check, trust company treasurer's check, bid bond as referenced in this Project Manual, or other form of security permitted by applicable law and acceptable to PennBid terms and conditions.

1.4 PREBID CONFERENCE

- A. A non-mandatory pre-bid conference for all bidders will be held at the project site. Bidders will meet at 9:00 A.M. at the project site located at 1963 East High Street, Pottstown, PA 19464. After the pre-bid conference, Bidders will be permitted to examine the areas of the Work.
- B. Prospective bidders are requested and strongly advised to attend the pre-bid meeting.
- C. Additional site visits shall be limited to the following times and require pre-registration with the Owner's Agent prior to 5:00 P.M. the day prior to the planned visits.
1. Wednesday, September 25, 2024; 1:00 P.M. to 4:00 P.M.
 2. Thursday, September 26, 2024; 9:00 A.M. to 12:00 P.M.
- D. Bidding documents will not be available at the pre-bid conference.

1.5 DOCUMENTS

- A. Online and Printed Procurement and Contract Documents: Contract documents are available for review via PennBid and purchase, at bidder's expense, via the Architect's office.

1. Cost for hardcopy Procurement and Contract Documents is \$700.00, plus cost of shipping, payable directly to the Architect.

- B. Inquiries and Requests for Interpretation should be directed to the Architect via PennBid. Phone calls will not be accepted. Answers regarding the scope of work or otherwise affecting the cost or performance of the Work will be issued to bidders in the form of an Addendum and shall be reflected and acknowledged on the Bid Form. Answers to valid questions will be issued in Addenda via PennBid. Last day for bidders to submit questions is four (4) business days prior to bid due date and last electronic upload of responses will occur no later than two (2) business days prior to bid due date.

1.6 TIME OF COMPLETION AND COST PENALTIES

- A. Bidders shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.
- B. Work is subject to liquidated damages for not achieving substantial completion by specified date, and cost penalties for not completing closeout and punch list requirements as identified in Section 017700 "Closeout Procedures" and Section 017823 "Operation and Maintenance Data".

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, and Insurance in a form acceptable to Owner will be required of the successful Bidder.
- B. Refer also to Section 013120 "Qualified Contractors" for additional bidder qualification information.

1.8 ADDITIONAL INFORMATION

- A. Notice is given that the Project for which construction bids are being solicited is a Project constituting public works in Pennsylvania and is subject to applicable provisions of the Pennsylvania Prevailing Wage Act, Act of August 15, 1961, P.L. 987. Appropriate prevailing minimum wage rates as promulgated under provisions of said Act must be paid by Contractors in connection with performance of Contract work.
 1. Wage Determination Schedule for this Project is provided at Document 007340.
- B. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.
- C. No bids may be withdrawn for a period of 60 days after opening of bids.

END OF DOCUMENT

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS

1.01 SECURING DOCUMENTS

- A. Contract Documents can be obtained only as stated in Document00 1116.

1.02 BID FORM

- A. In order to receive consideration, make all Bids in strict accord with the following:
 - 1. Make Bids upon the forms provided herein, properly executed and with all items filled out. Do not change the wording of the Bid Form, and do not add words to the wording of the Bid Form. Unauthorized conditions, limitations, or provisions attached to the Bid may be cause for rejection of the bid. Alterations by erasure or interlineation must be explained or noted in the Bid over the signature of the Bidder.
 - 2. Each Bid shall be submitted via PennBid and shall be completely uploaded on or before the day and hour set for receipt of Bids. PennBid's clock will determine prevailing time for receipt of Bids. It is the sole responsibility of the Bidder to see that his Bid is received on time. Owner will not be responsible for misdirected or late delivery of bids.
 - 3. Updates to the Bid Form may be issued up to and included in the issuance of the final Addendum document. Addenda shall be issued no later than TWO (2) business days prior to bid due date. Failure to submit bids on the latest bid form may result in incomplete bids and potential disqualification of the bid at the Owner's discretion.

1.03 BID BONDS

- A. A bid bond, certified check, or cashier's check, in the amount of 10 percent of the proposed Contract Amount must accompany each Bid and submitted in a format compliant with PennBid's terms and conditions. The successful Bidder's security will be retained until he has signed the Contract and furnished the required Performance Bond and Payment Bond, AIA A312. The Owner reserves the right to retain the security of the next two lowest bidders until the lowest Bidder enters into contract. If any Bidder refuses to enter into a Contract, the Owner will retain his bid bond.

1.04 OTHER BONDS

- A. Prior to signing the Contract, the Owner will require the selected Contractor to secure and post a Performance Bond and Payment Bond, Bonds shall be on AIA Form A312, or the form provided by Surety Company licensed to do business in the Commonwealth of Pennsylvania as per U.S. Department of the Treasury Department Circular 570, and naming as Obligee "Lower Pottsgrove Township", and attach Power of Attorney. Each Bond in the amount of 100 percent of the Contract Sum. Bonds shall be issued by Surety acceptable to the Owner. Include costs of bonds in proposed Contract Sum.

1.05 DEFINITIONS

- A. Bidding Documents include the Bidding Requirements and the proposed Contract Documents. Bidding Requirements consist of the Advertisement for Bids, Instructions to Bidders, Substitution Request Form, Available Project Information, and Bid Forms with Supplements.
- B. Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, 2017 edition, or in other Contract Documents are applicable to the Bidding Documents.

- C. Addenda are written or graphic instruments issued by the Architect prior to receipt of Bids, which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
- D. A Bid is a complete and properly signed proposal to do the work for the sums stipulated therein, submitted in accord with the Bidding Documents.
- E. The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.
- F. An Alternate is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.
- G. A Unit Price is an amount proposed by Bidders and stated on the Bid Form as a price per unit of measurement for materials or services that will be added to or deducted from the Contract Sum by Change Order in the event the estimated quantities of Work stipulated in the Contract Documents are increased or decreased.
- H. A Bidder is a person or entity who submits a Bid.
- I. Owner: The term "Owner" as used in the Bidding and Contract Documents refers to:
 - 1) Lower Pottsgrove Township, Montgomery County, 2199 Buchert Road, Pottstown, PA 19464.
 - 2) For the purposes of this Contract, the Owner's Agent may also act on behalf and with the authority of the Owner.
- J. Architect: The term "Architect" or "Architect" as used in the Bidding and Contract Documents refers to:
 - 1) MG Architects, 1268 Penn Avenue, Wyomissing, Pennsylvania 19610
- K. Contractor: The term "Prime Contractor" or "Contractor" as used in the Bidding and Contract Documents refer to the Contractor to whom an award is made to perform the Work and has entered into a direct contract agreement for construction activities with the Owner.
- L. Major Subcontractor: The term "Major Subcontractor" shall be any subcontract that exceeds 5% of the total prime contract value.
- M. Interpretations, corrections, and changes of the Bidding Documents will be made by Addenda. Interpretations, corrections, and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.
- N. Official Addenda issued to Bidders during the Bid Period by the Architect/Engineer listing modifications or interpretations of the Bidding Documents shall become a part and take precedence over original Bidding Documents as though originally included therein, and shall be so honored by Bidders in preparing their Bids.
- O. Addenda will be issued via PennBid only. Any other communications with the Owner, its Agent, the Architect or Engineer, whether written or verbal, shall not be considered a part of the Contract Documents.
- P. All pre-bid RFI's and other questions/comments from the prime contractors will be received and addressed by Architect. Subcontractors and vendors are required to go through their corresponding prime contractor for their inquiries.

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

1.06 PREVAILING MINIMUM WAGES

- A. The included prevailing minimum wages as predetermined by the Pennsylvania Department of Labor and Industry shall be paid to workmen employed in the performance of this Contract. Wage rates included in Section 007346 Application of these rates shall apply as required by the Pennsylvania Prevailing Wage law(s).

1.07 EXAMINATION OF SPECIFICATIONS AND SITE OF WORK

- A. Before submitting a Bid, each Bidder shall carefully examine the Contract Drawings, read the specifications and other proposed Contract Documents, and visit the site of the Work. Each Bidder shall fully inform himself prior to bidding as to existing conditions and limitations under which the Work is to be performed, and he shall include in his Bid a sum to cover costs of items necessary to perform the Work as set forth in the proposed Contract Documents. No allowance will be made to any Bidder because of lack of such examination or knowledge. Submission of a Bid will be construed as conclusive evidence that the Bidder has made such an examination.

1.08 AWARD OF CONTRACTS

- A. Award of Contract will be made if the Owner considers award to be in its best interests. Award will be made to the lowest responsive and Qualified and Responsible Bidder on the Base Bid or any combination of Base Bids and Alternates or any combination of Base Bids and Alternates for several contracts. Owner may also consider other factors which they feel have bearing on the Project. Owner reserves the right to waive any and all irregularities in a bid.
- B. Bidders may be required to submit duplicate sworn statements of their financial responsibility of recent date, technical qualifications and performance record before contracts can be awarded to them. In order that there may be no delay in the making of awards, bidders should be prepared to submit such statements within two calendar days of bid opening.
- C. No rights shall accrue to any person submitting a Bid or proposal until such bid has been accepted and contract awarded.
- D. Should apparent low bidder fail to meet the supplementary documentation requirements of the period following issuance of Intent to Award letter, the Owner reserves the right to disqualify the bidder and select the next lowest Qualified and Responsible Bidder.
- E. No Bidder shall be entitled to damages or other financial reimbursement if its bid is, in a manner consistent with these documents, disqualified or rejected during the bidding period up until when the contract is signed.

1.09 RETURN OF BID SECURITY

- A. Bid security of the three low Bidders for each contract will be retained until contracts have been awarded and agreements signed. Unless a request for return of bid bond accompanies the Bid, bid bonds will be destroyed. Certified checks and cashier's checks of all but the three low Bidders for each contract will be returned within two weeks after Bids are opened. Certified checks and cashier's check of the low three Bidders for each contract will be returned within two weeks after agreements are signed.

1.10 WITHDRAWAL OR MODIFICATION OF BIDS

- A. Bids may be withdrawn or modified not later than one minute before the time established for opening of Bids, without forfeiture of bid security. After that time, Bids may not be withdrawn for the time period stated on the Bid Form.
- B. A Bidder may request withdrawal of its Bid within two business days after the Bid opening time in accord with provided such request is compliant with all conditions set forth in Senate Bill No. 793 of the General Assembly of the Commonwealth of Pennsylvania approved January 23, 1974, and Pennsylvania Statute of 73 P.S. Section 1602. If the bid withdrawal request is granted, the Owner reserves all rights set forth in the bill.

1.11 PREPARATION OF BID

- A. Bid Form furnished by specification shall be used. Submit one completely executed copy and retain an original hard copy for records purposes.
- B. If the Bidder is a partnership, one unlimited partner shall personally initial each page of the Bid Form and shall sign the last page, having his signature witnessed by a duly licensed Notary Public.
- C. If the Bidder is a corporation, an officer who has authority to bind the corporation to a contract shall initial each page of the Bid Form and shall sign the last page, having his signature attested to by the secretary and treasurer of the corporation and the corporate seal affixed by his signature.
- D. Complete identity of the Bidder shall appear in the Bid Form. No Bid shall be made by an individual or partnership with an unregistered fictitious business style or by an unregistered foreign corporation.
- E. All blank spaces for Bid prices applicable to requested Prime Contract must be filled in. The use of the phrase "NO CHANGE or N/A" for any specific Alternate, or Unit Price shall be interpreted "no additional" or no change to the base bid amount. Bidders will not be permitted to modify or supplement that specific Bid. Further, the Owner reserves the right to consider these specific Bidder's Bids invalid, and reserves the right to award the contract upon any submittal or responsive and responsible Base Bid, Alternate, Unit Price, or combination thereof notwithstanding any irregularity or invalidity of other Alternate or Unit Price bids contained within that Bid. If anything other than a dollar amount is entered in a bid line item it shall be considered that the item of work is included in the bid at no additional add or deduct.
- F. Bidders may elect to submit bids for multiple prime contracts by meeting the following criteria:
 - 1. A complete bid application package must be received for each Prime Contract pursued by the Bidder.
 - 2. A Bidder may make no qualification of its bid based on award of any other Prime Contract.

1.12 SUBMISSION OF BIDS

- A. Bids shall be submitted via PennBid.

1.13 SUPPLEMENTS TO BID FORMS

- A. The following "Supplements to Bid Forms" are required to be submitted concurrent with the Bid and are listed on the Bid Form:
 - 1. Bid bonds shall be on AIA Form A310, or on the form provided by Surety Company
 - 2. Document 004519 - Non-Collusion Affidavit.
 - 3. Document 004512 - Contractor's Qualification Statement.
 - 4. Document 007400A – Qualified Contractor Certification Form.
- B. The following notification of apparent lowest responsive and qualified bidder and direction from the Architect, Qualified Contractor Certification Forms are required to be submitted by the Prime Contractors on behalf of all its major Subcontractors within five (5) business days:
 - 1. A breakdown of approximate percentages of total contract value ascribed to each Major Subcontractor.
 - 2. See Document 007400A – Qualified Contractor Certification Form.
 - 3. The Owner or Architect may request Certification forms from additional Subcontractors at their discretion following initial review of the submitted Subcontractor Certification forms and breakdown.
- C. A copy of each Supplement is furnished for Bidder's use. Bidders shall submit completely executed supplements via PennBid and retain original copies of each. In the case of discrepancies, the Owner may decide which to honor.
- D. Contractor and Subcontractors shall be licensed and registered to perform work in Pennsylvania. Firms with out-of-state headquarters or corporations not incorporated in Pennsylvania must submit, with their bid, a copy of their registration to do business in the commonwealth as provided by the Department of the State.
- E. If the apparent low Bidder is found unacceptable, or forfeits his bid bond, the next lowest responsible Bidder shall be required to submit the subsequent "Supplements". The process shall continue in like manner until all requirements are met.
- F. Submissions are to be accompanied by a transmittal form on the Bidder's letterhead. Bidder shall list only those items being submitted at that time.

1.14 EXECUTION OF CONTRACT

- A. A Contractor who is notified that he has been awarded the contract shall sign the Agreement within fourteen days after he receives such notification of award. At the signing, he shall furnish to the Owner, the Performance Bond, Labor and Material Bond, and Maintenance Bond required by Article 11, Section 11.4 of the Supplementary Conditions. If a Bidder fails to enter into the Contract or fails to furnish bonds within the fourteen calendar day period, he shall be liable to the Owner for the full amount of the Bid security as liquidated damage and not as a penalty for such failure.
- B. Owner and Contractor Agreement to be used is the AIA Document A101, Standard Form of Agreement between Owner and Contractor – 2017 Edition including all General and Supplemental Conditions as amended by the Owner.

1.15 INTERPRETATION OF CONTRACT DOCUMENTS PRIOR TO BIDDING

- A. If any person contemplating submitting a Bid for construction of the Work is in doubt as to the true meaning of any part of the proposed Contract Documents, he shall be obligated to

submit to the Architect a request for interpretation thereof before Bids will be opened, via electronic communication.

1. The person submitting the request shall be responsible for its prompt delivery.
2. Interpretation or correction of proposed Contract Documents will be made only by Addendum, and will be issued via PennBid only.
3. Architect and Owner will not be responsible for any other explanations or interpretations of the proposed Contract Documents.
4. Product substitution requests will not be reviewed or considered during the Bid Period.

B. Submit Requests for Interpretation/Information by doing the following:

1. Submit request via the PennBid portal.
2. Submit questions at least four (4) days prior of Bid period end.

1.16 CONSTRUCTION TIME AND LIQUIDATED DAMAGES

- A. Agreement between the Owner and Contractor will include a stipulation that the work be completed in the time period specified in the Contract Documents. Agreement will also include a stipulation that liquidated damages will be established per specification section 007200 "General Conditions" Section 007300 "Supplementary Conditions" (and acknowledged on the Bid Forms), per prime contractor, from Dates of Substantial Completion listed below. The imposition of liquidated damages does not preclude recovery from additional charges and claims by any other prime contractor.
- B. Schedule: Refer to section 013200 for schedule information. Contract will be based on following milestones:

- a.Assumed Notice to Proceed: October 24, 2024**
- b.Assumed Construction Start: November 25, 2024**
- c.Assumed Substantial Completion: October 31, 2025**

1.17 NON-COLLUSION AFFIDAVIT

- A. Each Bidder shall complete and submit the Non-Collusion Affidavit attached to the Bid Form, in accord with the following:
1. Non-Collusion Affidavit is material to any contract awarded pursuant to this Bid. According to the Pennsylvania Anti-Bid-Rigging Act, 73 P.S. 1611 et seq., governmental agencies may require Non-Collusion Affidavits be submitted together with Bids.
 2. This Non-Collusion Affidavit must be executed by the member, officer or employee of the Bidder who makes the final decision on prices and the amount quoted in the Bid.
 3. Bid rigging and other efforts to restrain competition, and the making of false sworn statements in connection with the submission of Bids are unlawful and may be subject to criminal prosecution. The person who signs the Affidavit should examine it carefully before signing and assure himself or herself that each statement is true and accurate, making diligent inquiry, as necessary, of all other persons employed by or associated with the Bidder with responsibilities for the preparation, approval or submission of the Bid.
 4. In the case of a Bid submitted by a joint venture, each party to the venture must be identified in the Bid Documents, and an Affidavit must be submitted separately on behalf of each party.
 5. Term "complementary bid" as used in the Affidavit has the meaning commonly associated with that term in the bidding process, and includes the knowing submission

of Bids higher than the Bid of another firm, any intentionally high or non-competitive Bid, and any other form of Bid submitted for the purpose of giving a false appearance of competition.

6. Failure to file an Affidavit in compliance with these instructions will result in disqualification of the Bid.

END OF DOCUMENT

DOCUMENT 003100 - AVAILABLE PROJECT INFORMATION

PART 1 - GENERAL

1.1 DOCUMENTS OF EXISTING CONDITIONS

- A. The following existing conditions documents are available for viewing by registered bidders at Architect's online plan room:
 - 1. Visiting Nurses Association of Pottstown – Architectural Drawings, dated 11/14/1995.
 - 2. Visiting Nurses Association of Pottstown – Structural Drawings, dated 10/30/1995.
 - 3. Land Development Plan for Twin County Construction Company, Inc., dated 3/17/1995.
- B. Owner neither certifies nor warrants the accuracy nor completeness of these documents, nor that the above and/or below grade construction shown is currently in place. Furthermore, these documents by their nature cannot reveal all conditions that exist at the site. Bidders are required to investigate existing conditions as best they are able and establish their bid based on site investigations.

1.2 SITE VISITATIONS

- A. As required by the General Conditions of the Contract, Bidders are strongly encouraged to visit the site and become familiar with existing and local conditions.
- B. Bidders shall comply with all rules and regulations established by Owner. Take adequate precautions and care to prevent disruptions to Owner activities.
- C. Exterior site observations may occur at any time during bidding process.
- D. For interior inspections the building shall be open during limited times. Prospective visitors shall send notification to the Owner's Agent by 5:00 P.M. local time the day prior to attending.
 - 1. The building shall be open for inspection during the following times only:
 - a. Wednesday, September 25, 2024; 1:00 P.M. to 4:00 P.M.
 - b. Thursday, September 26, 2024; 9:00 A.M. to 12:00 P.M.
 - 2. Owner's Agent:
 - a. Providence Consulting Associates, LLC.
 - b. Christopher Caggiano, President
 - c. ccaggiano1@gmail.com
 - d. 610.310.1759
- E. A non-mandatory pre-bid conference will occur on site as referenced in Document 001116, Invitation to Bid. A building walkthrough will take place following the meeting.
- F. Bidders shall visit the site and acquaint themselves with all existing conditions. Prior to bidding, Bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but all such investigations shall be performed only under time schedules and arrangements approved in advance by the Owner.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF DOCUMENT

DOCUMENT 004112 - BID SUBMISSION CHECKLIST

The following forms are required for a complete bid submission:

- ☐ Completed Bid Form
- ☐ Bidder's Qualification Form
- ☐ Qualified Contractor Certification Form
- ☐ Non-Collusion Affidavit
- ☐ Bid Security

END OF DOCUMENT

DOCUMENT 004113 - BID FORM

PROJECT IDENTIFICATION:

LOWER POTTS GROVE TOWNSHIP ADMINISTRATION BUILDING & POLICE STATION

BID TO: Lower Pottsgrove Township
2199 Buchert Road
Pottstown, PA 19464
Via PennBid

BID FROM:

Contractor Name: _____ Date: _____ 20__

Contractor Address: _____
_____ Zip Code _____

Contact Name: _____ Email _____

Contact Direct Phone: _____ Fax: _____

PRIME CONTRACT (check one):

☐ **GENERAL TRADES** ☐ **HVAC** ☐ **ELECTRIC** ☐ **PLUMBING**

(Complete a Separate Form for each Prime Contract you are Bidding if applicable)

1. The undersigned BIDDER agrees, if this Bid is accepted, to enter into an agreement with Owner, in the form included in Procurement Documents, to provide the Work as specified or indicated in Procurement Documents for Bid Price and within contract time indicated in this Bid and in accordance with the other terms and conditions of Procurement Documents.
2. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:
 - a. Owner has the right to reject this Bid or any portion of it and to waive any informality or irregularity in any Bid received.
 - b. This Bid will remain subject to acceptance for 60 days after the day of Bid opening.
 - c. BIDDER has examined the totality of all Procurement Documents whether or not relating to work scope being bid.
 - d. BIDDER accepts provisions of Instructions and Supplementary Instructions to Bidders, including disposition of Bid Security, General Conditions, and Supplementary Conditions.
 - e. BIDDER has reviewed Prevailing Wage Determination, this Bid Form, and project Addenda.

- f. BIDDER certifies that Alternates on Bid Form include costs of coordination of related Work, modification or adjustment to adjacent Work, miscellaneous devices, accessory objects, and similar item incidental to or required for a complete installation.
- g. BIDDER, for price stated, will provide and pay for all labor, materials, equipment, tools, machinery, transportation, superintendence of construction, permits and licenses, and incidental work. Work will be placed in an expeditious and workmanlike manner, will be completed to satisfaction and acceptance of Owner and Architect, and will be completed in accordance with the Contract Documents.
- h. BIDDER will sign and submit the Agreement with bonds and other documents required by Bidding Requirements within 15 days after the date of Owner's Notice of Award.
- i. BIDDER has visited the site and become familiar with the general, local, and site conditions.
- j. BIDDER agrees to comply with and be bound by applicable federal, state, and local laws and regulations affecting the work.
- k. BIDDER agrees to produce criminal history records of all employees and all employees of subcontractors working under BIDDER according to ACT 34 of 1985 and ACT 151 of 1994.
- l. BIDDER is aware of the general nature of work to be performed by Owner and others at the Site that relates to Work indicated in Procurement Documents.
- m. BIDDER has correlated the information known to BIDDER, information and observations obtained from visits to the site, reports, and drawings identified in Procurement Documents, and additional examinations, investigations, explorations, tests, studies, and data.
- n. BIDDER does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of Procurement Documents.
- o. BIDDER agrees that: this Bid is genuine and not made in the interest of or on behalf of an undisclosed person, firm, or corporation, and is not submitted in conformity with an agreement or rules of a group, association, organization, or corporation; BIDDER has not directly or indirectly induced or solicited another Bidder to submit a false or sham Bid; BIDDER has not solicited or induced a person, firm, or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself an advantage over another BIDDER or over OWNER.
- p. BIDDER agrees that the Bid Security Form and Qualified Contractor Certification Form have been reviewed. Bid Bond or certified check had been drawn to the order of the Owner in the amount listed in the Advertisement for Bids.

- q. BIDDER has received following Addenda, receipt of which is hereby acknowledged and included in this Bid Form:

Date	Number	Date	Number
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

3. BIDDER will complete the Contract Work in accordance with the Contract Documents, excluding Allowances, Unit Prices and Alternates, for the following price:

A. **STIPULATED SUM BID PRICE:** \$ _____

_____ (in words)

\$ _____ (in figures) **[A]**

B. **ALLOWANCES:** Allowances are described in Section 012100 "Allowances".

<u>ITEM</u>	<u>BID QTY</u>	<u>AMOUNT</u>
<u>General Construction Contract:</u>		
G-01: Concrete Sidewalk Replacement	200 SF	\$ _____
G-02: Floor Leveler	300 SF	\$ _____
Total Allowances (Sum of Allowances for Contract):		\$ _____ [B]

- C. BIDDER will complete the Contract Number **23-0047.0-**_____ for _____ Construction Work in accordance with the Contract Documents, **INCLUDING ALLOWANCES**, for the following price:

Stipulated Sum Bid Price: \$ _____ **[A]**

Total Allowances for Contract \$ _____ **[B]**

D. TOTAL STIPULATED SUM BASE BID, [A] PLUS [B]:

\$ _____

_____ (in words)

\$ _____ (in figures)

E. UNIT PRICES: Unit Prices are described in Section 012200 "Unit Prices".

<u>ITEM</u>	<u>UNIT</u>	<u>AMOUNT</u>
<u>General Construction Contract:</u>		
UG-01: Brick Masonry Repair/Repointing without Lift Equipment	Sq. Ft.	\$ _____
UG-02: Brick Masonry Repair/Repointing with Lift Equipment	Sq. Ft.	\$ _____
UG-03: Cutting and Patching of Existing Concrete Floor Slab	Sq. Ft.	\$ _____
UG-04: Floor Leveler	Sq. Ft.	\$ _____
UG-05: Interior Panel Signage	Each	\$ _____
UG-06: Asphalt Replacement	Sq. Yd.	\$ _____
UG-07: Concrete Sidewalk Replacement	Sq. Ft.	\$ _____
UG-08: Concrete Curb Replacement	Lineal Ft.	\$ _____
<u>HVAC Construction Contract:</u>		
UH-01: Ductwork	Pound	\$ _____
UH-02: Access Doors	Each	\$ _____
<u>Electrical Construction Contract:</u>		
UE-01: Duplex Receptacle	Each	\$ _____

UE-02: Data Receptacle Each \$ _____

UE-03: Illuminated Exit Sign & Wiring Each \$ _____

UE-04: Fire Alarm Audible/Visual Device & Wiring Each \$ _____

UE-05: 20A Wiring in Conduit Lineal Ft. \$ _____

UE-06: 20A Wiring in MC Lineal Ft. \$ _____

Plumbing Construction Contract:

UP-01: Ball Valve (1/2 inch dia.) Each \$ _____

UP-02: Ball Valve (3/4 inch dia.) Each \$ _____

UP-03: Ball Valve (1 inch dia.) Each \$ _____

UP-04: Copper Piping (1/2 inch dia.) Lineal Ft. \$ _____

UP-05: Copper Piping (3/4 inch dia.) Lineal Ft. \$ _____

UP-06: Copper Piping (1 inch dia.) Lineal Ft. \$ _____

UP-07: Sprinkler Head Assembly Each \$ _____

- F. **ALTERNATES:** Bidder submits the following Alternates that may be selected by Owner as part of the Agreement. Provide items in compliance with applicable specification Sections in Contract Documents. Identify Alternate as an 'ADD TO' or 'DEDUCT FROM' the Base Bid amount by circling the applicable designation. Alternates are described in Division 01, Section "Alternates".

Alternate G-01: Replace Horizontal Siding and Attic Dormer Windows

ADD: _____

_____ Dollars \$ _____ (in figures)

Alternate E-01: Deduct Purchase of New Emergency Generator

DEDUCT: _____

_____ Dollars \$ _____ (in figures)

4. Omission of Owner requested price information is sufficient reason to reject submitted Bid.
5. Competency and responsibility of BIDDER is a consideration in the Award of the Contract.
6. BIDDER agrees to progress the Work in accordance with the predetermined schedule and to achieve Substantial Completion within Contract Time as defined by the Agreement.
7. BIDDER agrees that bid security will be forfeited as Liquidated Damages, not as a Penalty, if BIDDER fails to furnish the required bonds and insurance coverages within 10 days of receipt of written Notice of Award of Contract or fails to execute and deliver the Agreement for the Work within 10 days after receipt of it.
8. BIDDER agrees that the Owner will sustain extensive damage and serious loss as a result of the Contractor's failure to complete the Work within the time noted in the Invitation to Bid. Therefore, the Owner and BIDDER agree that in the event that the BIDDER fails to meet the schedule set forth in the Contract Documents, the Owner shall be entitled to retain or recover from the BIDDER, as liquidated damages and not as a penalty, as established in the Supplementary Conditions to the Contract, Section 8.3.5.
9. BIDDER agrees to procure Qualified Contractor Certification forms for each of its major Subcontractors and submit to Architect within five (5) days of being notified that they are the apparent low bidder, following requirements of the Qualified Contractor specification.
10. The following Documents are attached to and made a condition of this Bid:
 1. Bid Security.
 2. Contractor's Qualification Statement.
 3. Qualified Contractor Certification Form.
 4. Non-Collusion Affidavit.
12. BIDDER agrees to type of business by placing an X on one of the following lines to identify whether it is trading under a Fictitious Name:
 1. Individual: _____
 2. Partnership: _____
 3. Corporation: _____
 4. Trading under a Fictitious Name: _____

13. The undersigned hereby certifies that it has reviewed all bidding documents and is authorized to act on the behalf of BIDDER.

Contractor Authorized Representative: _____
printed name

Signature: _____

Title: _____

Date: _____ (SEAL)

END OF DOCUMENT

DOCUMENT 004300 - PROCUREMENT FORM SUPPLEMENTS AND CERTIFICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Identifies:
 - 1. Various supplementary forms to be used during bidding period, forms to be submitted with Bid Form, and forms used during construction.
 - 2. Various representations and certifications to be submitted as a means of substantiating that Bidder meets stipulated qualifications and has capability to complete the Work.
- B. For Documents not provided in Project Manual, submit information on Bidder's letterhead.

1.2 QUALIFICATIONS

- A. Information and submittals required by this Document are an integral part of the Bid Form and the bidding process.

1.3 FORMS SUBMITTED DURING THE BIDDING PERIOD

- A. Submit Substitution Request Form prior to ten (10) calendar days before bid date if requesting a material substitution. Comply with other requirements specified elsewhere in Procurement Documents.

1.4 FORMS USED DURING THE BIDDING PERIOD AND CONSTRUCTION PERIOD

- A. Use the following forms when preparing each Bid:
 - 1. Wage Rate Determination, which follows Document 007346.
 - 2. Qualified Contractor Certification Form, for major Subcontractors.

1.5 FORMS SUBMITTED WITH THE BID

- A. Bidders shall submit the following forms with the Bid Form:
 - 1. Bid Security Form.
 - 2. Contractors Qualification Statement
 - 3. Qualified Contractor Certification Form
 - 4. Non-Collusion Affidavit.
- B. Bids submitted without procurement supplement forms properly completed will be considered incomplete and non-responsive.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT

DOCUMENT 004519 - INSTRUCTIONS FOR NON-COLLUSION AFFIDAVIT

1. This Non-Collusion Affidavit is material to any Contract awarded pursuant to this bid. According to the Pennsylvania Antibid-Rigging Act, 75 P.S. 1611 et seq., governmental agencies may require Non-Collusion Affidavits be submitted with bids.
2. Non-Collusion Affidavit must be executed by member, officer or employee of bidder who makes final decision on prices and amount quoted in bid.
3. Bid rigging and other efforts to restrain competition and making false sworn statements in connection with submission of bids are unlawful and may be subject to criminal prosecution. Persons who sign Affidavit should examine it carefully before signing and be assured each statement is true and accurate, making diligent inquiry, as necessary, of other persons employed by or associated with bidder with responsibilities for preparation, approval or submission of bid.
4. In case of a bid submitted by a joint venture, each party to venture must be identified in bid documents, and an Affidavit must be submitted separately on behalf of each party.
5. Term "complementary bid" as used in Affidavit has meaning commonly associated with that term in bidding process and includes knowing submission of bids higher than bid of another firm, any intentionally high or noncompetitive bid, and any other form of bid submitted for purpose of giving a false appearance of competition.
6. Failure to file an Affidavit in compliance with these instructions may result in disqualification of bid.

DOCUMENT 004519
NON-COLLUSION AFFIDAVIT

Contract/Bid No. _____

State of:

County of:

I state I am _____ of _____
(Title) (Name of my Firm)

And I am authorized to make this Affidavit on behalf of my firm, and its Owners, directors, and officers. I am person responsible in my firm for price(s) and amount of bid.

I state that:

1. Price(s) and amount of bid have been arrived at independently and without consultation, communication or agreement with any other contractor, bidder or potential bidder.
2. Neither price(s) nor amount of bid, and neither approximate price(s) nor approximate amount of bid, have been disclosed to any other firm or person who is a bidder or potential bidder, and will not be disclosed before bid opening.
3. No attempt has been made or will be made to induce any firm or person to refrain from bidding on this contract, or to submit a bid higher than this bid, or to submit any intentionally high or noncompetitive bid or other form of complementary bid.
4. Bid of my firm is made in good faith and not pursuant to any agreement or discussion with, or inducement from, any firm or person to submit a complementary or other noncompetitive bid.
5. _____

(Name of My Firm)

Its affiliates, subsidiaries, officers, directors and employees are not currently under investigation by any governmental agency and have not in last four years, been convicted or found liable for any act prohibited by State or Federal law in any jurisdiction, involving conspiracy or collusion with respect to bidding on any public contract, except as follows:

I state that _____
- (Name of My Firm)

Understands and acknowledges the above representations are material and important, and will be relied on by

(Name of Public Entity)

In awarding contract(s) for which this bid is submitted. I understand and my firm understands any misstatement in this affidavit is and shall be treated as fraudulent concealment from:

(Name of Public Entity)

of true facts relating to submission of bids for this contract.

(Signature and Company Position)

SWORN TO AND SUBSCRIBED

BEFORE ME THIS ____ DAY OF _____

NOTARY PUBLIC

My Commission Expires: _____

END OF DOCUMENT

DOCUMENT 005200 - AGREEMENT FORM

PART 1 - GENERAL

1.1 AGREEMENT FORM

- A. Owner and Contractor Agreement to be used is the American Institute of Architects (AIA) Document A101, STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR - 2017 Edition, subsequently referred to as the Agreement, and as amended by the General and Supplementary Conditions of the Contract set forth in the Project Manual.
- B. The Agreement will be completed for signature by Owner and Contractor prior to initiating any Work.
- C. An Agreement will be completed for each project Prime Bid accepted by Owner.
- D. The Agreement is specifically made a part of the Contract Documents referenced with the same force and effect as though set forth here in full.
- E. A sample copy of AIA Document A101 follows this Document.

1.2 RELATED DOCUMENTS

- A. Document 006100 - Bonds.
- B. Document 007200 - General Conditions.
- C. Document 007300 – Supplementary Conditions of the Contract

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT



Document A101™ – 2017

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

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

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

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

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

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

The Owner and Contractor agree as follows.

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

The parties should complete A101™-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement.

AIA Document A201™-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

TABLE OF ARTICLES

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

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

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

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

(Check one of the following boxes.)

- ☐ The date of this Agreement.
- ☐ A date set forth in a notice to proceed issued by the Owner.
- ☐ Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

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

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

§ 3.3 Substantial Completion

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

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

Init.

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

[] By the following date:

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

Portion of Work	Substantial Completion Date

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

ARTICLE 4 CONTRACT SUM

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

§ 4.2 Alternates

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

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.

(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:

(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:

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

Item	Units and Limitations	Price per Unit (\$0.00)

§ 4.5 Liquidated damages, if any:

(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:

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

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

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

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

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

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

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

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

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

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

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

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

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

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

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

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

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

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

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

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

§ 5.2 Final Payment

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

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

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

§ 5.3 Interest

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

(Insert rate of interest agreed upon, if any.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

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

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

- ☐ Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- ☐ Litigation in a court of competent jurisdiction
- ☐ Other *(Specify)*

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

ARTICLE 7 TERMINATION OR SUSPENSION

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

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

§ 8.2 The Owner's representative:

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

§ 8.3 The Contractor's representative:

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

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

§ 8.5 Insurance and Bonds

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

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

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

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

.8 Other Exhibits:

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

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

- [] The Sustainability Plan:

Title	Date	Pages

- [] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

- .9 Other documents, if any, listed below:

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

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

OWNER (Signature)

(Printed name and title)

CONTRACTOR (Signature)

(Printed name and title)

Init.

DOCUMENT 006100 - BONDS

PART 1 - GENERAL

1.1 PERFORMANCE AND PAYMENT BOND

- A. Successful Bidder entering into an Agreement with Owner shall submit completed Performance Bond and Labor and Material Payment Bond on American Institute of Architects (AIA) Document A312, 2010 Edition, PERFORMANCE BOND AND PAYMENT BOND.
- B. Those documents are referenced with same force and affect as though set forth here in full.
- C. A sample copy of AIA Document A312 follows this Document.

1.2 RELATED DOCUMENTS

- A. Document 005200 - Agreement Form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT

DOCUMENT 006200 - CERTIFICATES AND OTHER FORMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes multiple forms required by Owner, Architect, Authorities Having Jurisdiction and other Agencies that are required for permitting, approvals, and construction administration activities.
- B. Submit certificates and other forms at appropriate times prior to, during, and post construction as coordinated by Construction Manager.

1.2 RELATED DOCUMENTS

- A. Document 006100 - Bonds.
- B. Document 007200 - General Conditions.

1.3 CERTIFICATES AND OTHER FORMS

- A. Submittal Cover Sheet: Use under provisions of Section 013300 "Submittal Procedures".
- B. Certificate of Insurance Form.
- C. Qualified Contractor Certification Form. Use under provisions of Section 007400 "Qualified Contractors."
- D. Schedule of Values Form (AIA G703 or equivalent).
- E. Stored Materials Form.
- F. Construction Schedule Form.
- G. Sales Tax Statement and Certification Form.
- H. Acord 25-S Form (Certificate of Liability Insurance).
- I. Contractor's Application for Payment Form; AIA G702 or equivalent.

1.4 CLARIFICATION AND MODIFICATION FORMS

- A. Substitution Request Form; used during construction.
- B. Request for Information Form.

1.5 CLOSEOUT FORMS

- A. Certificate of Compliance Form.
- B. Certificate of Substantial Completion Form.
- C. Certificate of Completion Form:
 - 1. Affidavit of Payment of Debts and Claims Form.
 - 2. Affidavit of Release of Liens Form.
 - 3. Consent of Surety to Final Payment Form.
 - 4. Acceptance of Certificate Form.
- D. Warranty Form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT

DOCUMENT 007200 - GENERAL CONDITIONS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS FORM

- A. General Conditions of this Contract to be used is American Institute of Architects (AIA) Document A201, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION - 2017 Edition, subsequently referred to as General Conditions.
- B. General Conditions are specifically made a part of Contract Documents with same force and effect as though set forth here in full.
- C. AIA Document A201-2017, as modified for this Project with additions and deletions identified, follows this Document.
- D. Specification Section 007300 titled "Supplementary Conditions of the Contract" covers all additions and deletions applicable to AIA Document A201.

1.2 DEFINITIONS

- A. General Conditions: Contents of AIA Document referenced in this Document 007200.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT



AIA[®]

Document A201[™] – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

THE OWNER:

(Name, legal status and address)

THE ARCHITECT:

(Name, legal status and address)

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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User Notes:

(1313097273)

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

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

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

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

§ 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

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forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

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

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

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

§ 3.5 Warranty

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

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

§ 3.6 Taxes

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

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately

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

§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent

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

§ 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.

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

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not

have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

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

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

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

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

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

§ 5.3 Subcontractual Relations

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

similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

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

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

§ 6.2 Mutual Responsibility

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

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the

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Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

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

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

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

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

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

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

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;

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- .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.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

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

§ 9.3 Applications for Payment

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

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

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

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

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

§ 9.4 Certificates for Payment

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

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

§ 9.5 Decisions to Withhold Certification

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

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

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

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§ 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.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

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

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

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

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

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

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

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

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

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

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

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

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

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

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

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

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

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

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§ 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

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the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

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

§ 12.2.2 After Substantial Completion

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

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

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

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

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

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

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

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

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

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

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

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

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

§ 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,

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the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

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

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

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

§ 14.4 Termination by the Owner for Convenience

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

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

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

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

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

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

§ 15.1.2 Time Limits on Claims

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

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim 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 in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

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

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

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

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

§ 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.

SECTION 007300 - SUPPLEMENTARY CONDITIONS OF THE CONTRACT

THE FOLLOWING SUPPLEMENTS MODIFY, CHANGE, DELETE FROM, OR ADD TO THE "**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**", AIA DOCUMENT A201-2017 edition. WHERE ANY ARTICLE OF THE GENERAL CONDITIONS IS MODIFIED, OR ANY PARAGRAPH, SUBPARAGRAPH, OR CLAUSE THEREOF IS MODIFIED OR DELETED BY THESE SUPPLEMENTARY CONDITIONS, THE UNALTERED PROVISIONS OF THAT ARTICLE, PARAGRAPH, SUBPARAGRAPH, OR CLAUSE SHALL REMAIN IN EFFECT. IN THE EVENT OF ANY DISCREPANCY BETWEEN THE GENERAL CONDITIONS AND THESE SUPPLEMENTARY CONDITIONS, THESE SUPPLEMENTARY CONDITIONS SHALL CONTROL. NUMBERING INDICATED FOR NEW PARAGRAPHS, SUBPARAGRAPHS OR CLAUSES IS CONSECUTIVE TO THAT OF THE UNALTERED AIA DOCUMENT A232-2019.

THIS DOCUMENT SHALL APPLY TO ALL PRIME CONTRACTS

1.1 Change Subparagraph 1.1.1

Replace the last sentence with: "The Contract Documents shall include Bidding Requirements, including, but not limited to, advertisement or Invitation to Bid, Instructions to Bidders, bid period requests for information (RFI's), the Contractor's Bid, and Addenda or portions of the Addenda relating to any Bidding Documents."

1.2 Add the new Subparagraph "1.1.11, Miscellaneous Definitions" and following Subparagraphs:

1.1.11.1 The terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Architect" and similar phrases. However, no implied meaning shall be interpreted to extend the Architects' responsibility into the Contractor's area of construction supervision.

1.1.11.2 The term "approved" where used in conjunction with the Architect's action on the Contractor's submittals applications and requests is limited to the responsibilities and duties of the Architect stated in General and Supplementary Conditions acting as the Agent of the Owner. Such approval shall not release the Contractor from responsibility to fulfill Contract Document requirements, unless otherwise provided in the Contract Documents.

1.1.11.3 The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation and similar operations." It is acknowledged that Owner will supply certain materials, but Contractor shall be responsible for its delivery.

1.1.11.4 The term "install" is used to describe operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning, and similar operations.

1.1.11.5 The term "provide" means to furnish and install complete in place, tested and approved.

1.1.11.6 The term "an installer" is an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

The term "experienced" when used with the term "installer" means having a minimum of five (5) previous projects similar in size and scope to this Project and familiar with the precautions required and has complied with requirements of the authority having jurisdiction."

1.1.11.7 The term "product" includes materials, systems and equipment.

1.1.11.8 The term "building code" and the term "code" refer to regulations of governmental agencies having jurisdiction.

1.1.11.9 The term "similar" means in its general sense, and not necessarily identical.

1.1.11.10 The terms “shown”, “indicated”, “detailed”, “noted”, “scheduled” and terms of similar import, refer to requirements contained in the Contract Documents.

1.1.11.11 Where reference to “the Contractor” is made in AIA General Conditions of the Contract for Construction, Supplementary General Conditions and Instructions to Bidders, it shall mean “each” Contractor, unless specified otherwise.

1.1.11.12 Acronyms may be utilized throughout the Contract Documents to assign work to specific prime contractors. In these cases, “GC” shall refer to the General Trades Contractor, “EC” shall refer to the Electrical Prime Contractor, and “PC” shall refer to the Plumbing Prime Contractor. “MC”, “HC”, “HVAC” shall all refer to the HVAC Prime Contractor. “RC” shall refer to the Roofing Prime Contractor when applicable to a given project.

1.3 Add the following Subparagraph 1.2.4:

“1.2.4 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

- A. The Agreement between Owner and Contractor, AIA Document A101-2017 edition.
- B. Addenda, with those of later date having precedence over those of an earlier date.
- C. The Supplementary Conditions of the Contract.
- D. The General Conditions of the Contract for Construction, AIA Document A201-2017 edition.
- E. Drawings and Specifications.
 - 1. In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by Addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architect's interpretation.”
 - 2. In the case of a discrepancy between the Drawings and Specifications where quality or quantity is not clearly inferable, the Specifications shall govern.

1.4 Add new Subparagraph 1.2.5 as follows:

“1.2.5 Notations which apply to one of a number of similar situations, materials, or processes shall be deemed to apply to all except where indicated to the contrary. All manufactured material and equipment shall be installed and used in accordance with the manufacturer's instructions unless specifically otherwise directed in the Contract Documents.”

1.5 Add new Subparagraph 1.2.6 as follows:

“1.2.6 Contractor acknowledges that the plans and specifications are intended only to show the intent of the completed Project. Contractor represents that it is qualified to construct the Project as depicted in the Contract Documents and to determine its own means, methods, techniques, sequences and procedures. To the extent that means, methods, techniques, sequences and procedures are identified in the Contract Documents, Contractor is required to independently evaluate those means, methods, techniques, sequences and procedures for the purpose of determining whether the means, methods, techniques, sequences and procedures depicted in the Contract Documents are adequate to construct the Project. Contractor further represents that it has based its bid upon its own determination of the means, methods, techniques, sequences and procedures required to construct the Project.”

1.6 Move text of Paragraph 1.4 to Subparagraph 1.4.1. Retain “1.4 Interpretation” heading.

1.7 Add new Subparagraph 1.4.2 as follows:

“1.4.2 To the extent that the Contractor makes a representation in the conditions of the Contract, any such representation is a contractual obligation required to be performed and is a representation to the Owner and Architect upon which each of them are entitled to rely.

1.8 Delete last sentence of Paragraph 1.7.

1.9 Add new Subparagraph 1.7.1 as follows:

“1.7.1 The Architect will make available to the Contractor, upon request, Digital Data files of selected contract drawings for the Contractor's purposes solely and exclusively to perform services or construction for the project. The Contractor shall request Digital Data files of specific drawings using the Electronic Media Release Form provided by the Architect. Upon receipt of the Release Form, Digital Data files of the requested drawings will be forwarded to the Contractor via a compact disc or through an “FTP type” website established for the project.

1.10 Add the following Subparagraph 1.7.2:

“1.7.2 In the event the Contractor requests and receives Digital Data or similar electronic files of project documents for use in the execution of the Work of this project, it is with the understanding that the Digital Data or electronic files provided are for informational purposes only and may not necessarily represent the final and/or complete design of the project and its systems. The Contractor shall not rely on the accuracy of the information provided but shall be responsible to verify all information and actual project conditions.

Neither the Owner nor Architect assumes responsibility for the information contained on the Digital Data or electronic files or the subsequent use of the information. The Owner and Architect caution any user of the Digital Data or electronic files that subsequent changes may have been made to the Project and/or Contract Documents which may not be reflected on the electronic files. Only final stamped drawings represent an accurate record of the Architects' design.

To the fullest extent permitted by law, the Contractor shall indemnify and defend the Owner, Architect and their respective officers, directors, representatives, insurers, agents, employees and assigns from and against all claims, actions, damages, losses and costs arising from or related to the Contractor's request for and use of Digital Data or electronic project document files, including, but not limited to, any errors, omissions, anomalies, or variances contained therein.”

1.11 Delete last sentence of Paragraph 1.8.

2.1 Replace Subparagraph 2.1.1 with the following:

“2.1.1 The bidder agrees and acknowledges that the Owner is a “contracting body” under the Public Works Contractor's Bond Law of 1967, and the Work on the Project is public construction and not subject to the filing of Mechanics Liens, and further agrees to provide and specify in its subcontracts with Subcontractors and Suppliers for their acknowledgment that their sole remedy against the Owner exists only under the provisions of the Bond Law and in accordance with the Payment Bond and to indemnify and hold harmless the Owner from any claim under the Mechanics Law Lien, filed by its Subcontractors and Suppliers.”

2.2 Delete Paragraph 2.2 and associated subparagraphs 2.2.1, 2.2.2, 2.2.3, 2.2.4.

2.3 Replace Subparagraph 2.3.1 as follows:

"The Contractor, unless noted otherwise per the terms of this Project, shall secure and pay for all necessary approvals, assessments and permits for the scope of its work from the requisite Authorities Having Jurisdiction."

2.4 Add the following Subparagraph 2.3.1.1"

"2.3.1.1 The Owner shall secure and pay for the general construction permit."

2.5 Replace Subparagraph 2.3.5 with the following:

"**2.3.5** The Owner shall not be responsible for furnishing surveys (unless required for the execution of the work and requested by the Contractor in writing) or other information as to the physical characteristics of legal limitations of or utility locations for the Project site, but shall furnish or cause to be furnished to the Contractor a legal description of the Project site, which shall not constitute one of the Contract documents. Contractor shall confirm the location of each utility, shall excavate and dispose of each on-site utility and shall cap each off-site utility as required by the Work and as may be included in the Specifications. The Contractor represents that it is familiar with the Project site and has received all information it needs concerning the condition of the Project site. The Contractor represents that it has inspected the location of the Work and has satisfied itself as to the condition thereof, including, without limitations, all structural, surface, and subsurface conditions. The Contractor shall exercise special care in executing subsurface work in proximity of known subsurface utilities, improvements, and easements."

2.6 Add the following Subparagraph 2.3.5.1:

"**2.3.5.1** The Owner will make available to the Contractor such soil borings tests and reports as it may have available, but in no event shall such information constitute any warranty or representation by the Owner as to the accuracy of such information."

2.7 Change Subparagraph 2.3.6 as follows:

Replace the text "one" with "a digital copy in PDF format"

2.8 Change Paragraph 2.4 as follows:

In the first sentence after the words, "the Owner may" insert the following: "- in addition to all other remedies available at law or hereunder -".

2.9 Add the following Subparagraph 2.4.1.1:

"**2.4.1.1** This right shall be in addition to and not in restriction or derogation of the Owner's rights under Section 2.4 or Article 14 hereof. The Owner's right to stop the Work shall not relieve a Contractor of any of its responsibilities and obligations under or pursuant to the Contract Documents."

2.10 Change Paragraph 2.5 as follows:

In the first sentence:

- Change "ten-day period" to read "five-day period."
- Change the words, "...without prejudice to other remedies the Owner may have, correct such deficiencies." to read: "...without prejudice to other remedies the Owner may have, *immediately* correct such default or neglect."

Insert after the first sentence the following: "In such case an appropriate Change Order or Construction Change Directive shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses, attorney's fees and compensation for the Architect's and its respective consultants' additional services made necessary by such default, neglect or failure."

3.1 Delete Subparagraph 3.2.1 and replace with the following:

"3.2.1 The Contractor warrants that it has carefully studied and reviewed the Contract Documents and has reported any errors, inconsistencies or omissions to the Architect. The Contractor hereby acknowledges and declares that to Contractor's knowledge the Contract Documents are full and complete, are sufficient to have enabled the Contractor to determine the cost of the Work and fulfill all of the Contractor's obligations under the Contract Documents. Contractor represents that it has the knowledge, skill and expertise to perform the work; that it understands that it must make reasonable inferences to determine portions of the work not shown in the Contract Documents that would be required for a proper and complete project, and it has included all costs for such inferences in its bid; and, that contractor is not relying on representations from the contract documents for the purpose of determining the means, methods, sequences or procedures of performing the work. The Contractor shall immediately report any error, inconsistency, or omission it encounters to the Architect for resolutions. If the Contractor performs any construction activity knowing or having reason to know that it involves an error, inconsistency or omission, the Contractor shall bear the cost of construction."

3.2 Delete Subparagraph 3.2.3 and replace with the following:

"3.2.3 It shall be the obligation of the Contractor to review the Contract Documents to determine and to notify the Architect of any discrepancy with the building codes and regulations of which the Contractor has knowledge or should be reasonably able to determine. The Contractor shall not violate any zoning, setback or other locational requirements of applicable laws, codes and ordinances, or any recorded covenants of which the Contractor has knowledge. If the Contractor observes that portions of the Contract Documents are at variance with applicable laws, statutes, ordinances, building codes, rules or regulations, the Contractor shall notify the Owner and Architect in writing, and necessary changes shall be accomplished by appropriate Modification."

3.3 Delete Subparagraph 3.2.4

3.4 Change Subparagraph 3.3.2 as follows:

In the second line after "agents and employees," insert "Suppliers and their agents and employees,"

3.5 Add the following Subparagraph 3.3.2.1:

"3.3.2.1 Contractors shall be responsible to protect their installed work until such work is turned over to and accepted by the Owner in writing. Any damage to such work shall be corrected by the Contractor initially responsible for the work, regardless of how the damage was sustained."

3.6 Add the following Subparagraphs 3.3.4 through 3.3.11:

"3.3.4 The Contractor shall perform its Work in accordance with the Contract Documents and in a professional, businesslike and workmanlike manner. Among other things, at completion of the Work, the Contractor shall thoroughly clean the site and remove from the site all tools, equipment, obstructions and debris resulting from the Work.

3.3.5 The Contractor shall abide by all federal, state and local legal requirements applicable to this project, including requirements imposed by statute, regulation, code, ordinance, administrative rule or by order of any court or administrative agency. This includes, but is not limited to, requirements governing health, safety, labor and environmental protection. Among other things, the Contractor shall submit an MSDS form (or other required form) and proper labeling to the Architect in advance of each chemical being used.

3.3.6 The Contractor's Work shall be at all times subject to the inspection and approval of the Owner or Architect. Any materials that in the opinion of the aforementioned parties do not comply with the Contract Documents will be rejected and shall be immediately removed from the site. Any workmanship that in the opinion of the aforementioned parties does not comply with the Contract Documents shall be stopped at once, and corrective measures shall be instituted at once.

3.3.7 For a Project with multiple prime contractors, all Contractors are responsible for the coordination and integration of their respective scopes of Work. The General Trades Contractor is responsible for making all coordination decisions not mutually agreed upon by affected Contractors. The Owner and its consultants or agents shall not be liable for any costs incurred by any Contractor due to failure of Contractors to coordinate and integrate their Work or due to any delays in the Work. If a Contractor causes damages or additional costs to another Contractor (including by causing delays, interferences, hindrances, loss of efficiencies or acceleration of Work), an adversely impacted Contractor will have a third-party beneficiary claim for legal action against the responsible Contractor. All Contractors acknowledge and accept the right of other Contractors to bring such third-party beneficiary claims, waive any privity of contract defense against such claims, and agree not to include the Owner, its professional consultants or agents, as parties in any such legal action.

3.3.8 Contractor shall not assign its duties under this Agreement without the express written approval of Owner."

3.3.9 After Award of Contract, any claims for additional costs associated with completion of the Work within the required Contract time frames will not be considered. Contractors must recognize that although their work might not require shift, overtime, or premium time work for completion within the stipulated time frame, it may be required in order to allow other Contractors to complete within the specified time. Failure to recognize the extra costs in his bid shall not relieve the Contractor from utilizing shift, overtime, or premium time work in performance of his Contract nor entitle him to additional compensation. Where installation work is part of the contract, all costs associated with meeting the time frames indicated in the construction schedules shall be included in the contract price.

3.3.10 If the Contractor fails to supervise his workmen or subcontractors, the Owner shall withhold monies sufficient to protect the Owner's interest.

3.3.11 No verbal agreement or conversation with any officer, agent or employee of the Owner or Architect, either before or after the execution of the contract, shall affect or modify the terms or obligations herein contained. Failure to comply with any or all of the above requirements will not relieve the contractor from the responsibility of properly estimating the difficulty or cost of successful completion of the work, nor from the responsibility for the faithful performance of the provisions of this contract."

3.7 Change Subparagraph 3.4.3 as follows:

Append the following: "The Contractor shall inform all workers on the Project of proper conduct expected of them by the Owner at all times. Fraternization between the workers and the adjacent building occupants (if present), obscene gestures, obscene pictorial, printed and/or written expressions and the use of profanity by the workers is forbidden."

3.8 Add the following Subparagraphs 3.4.4 through 3.4.11:

3.4.4 All persons employed by the Contractor to perform the Work shall be competent and first-class workmen and mechanics, who are duly skilled in their respective branches of labor.

3.4.5 Should the Owner object in writing to any personnel of Contractor or any Subcontractor, such personnel shall not perform services on the Project, and there shall be no change in the Contract Sum as a result of such objection.

3.4.6 The Contractor shall assign an on-site Superintendent for the project who shall not be replaced so long as the Superintendent remains in the Contractor's employment without written consent by the Owner, and who shall be replaced without any change in the Contract Sum if the Owner, in its discretion, so requires.

3.4.7 The Contractor in making or ordering material shipments shall not consign or have consigned materials, equipment or any other items in the name of the Owner. The Owner shall not be under any obligation to make payment for charges or deposits on shipments made by or to the Contractor but may, at its option, pay such charges in which case the Contractor shall reimburse the Owner for the amount of such payments plus a service charge of twenty-five percent (25%) of the amount so paid.

3.4.8 Contract Sum Not Adjusted for Rising Costs: The Bid (and hence the Contract Sum) for the Contract must be guaranteed for the duration of the Project and shall thereby have incorporated within it any or all escalation factors related to market conditions. Notwithstanding any other provision in the Contract Documents to the contrary, Contractor's Contract Sum is intended to include all increases in cost, foreseen or unforeseen, including, without limitation, increases in costs arising from supply shortages, unusual delay in deliveries, increases in market prices for materials, labor, taxes and/or other causes beyond the Owner's control, all of which are to be borne solely by the Contractor supplying the materials and/or labor to the Project. All loss and/or damage arising from any of the Work performed under this Agreement through unforeseen or unusual obstructions, difficulties or delays which may be encountered in the prosecution of same shall be borne solely by the Contractor prosecuting the Work."

3.4.9 The Contractor shall assure that his employees comply with the following:

- .1 The contractor is solely responsible for the safety of his employees and for assuring compliance with OSHA rules and regulations as stated in the project specifications.
- .2 Construction security means that the Contractor shall be responsible to protect and secure his own tools, equipment and materials. He is also responsible to protect the Owner's property and facilities which he occupies or uses.
- .3 Workers shall not operate audio devices in a manner that may be considered a disturbance to construction activity and/or surrounding neighborhood.
- .4 Dress in accordance with OSHA requirements.
 - a. Clothing shall not bear references to tobacco, drugs, alcoholic beverages, and/or profanity.
- .5 No use of building restrooms, once completed.
- .6 Stay out of building areas which are not a part of construction.
- .7 Do not use any facility, materials or equipment without specific permission.
- .8 Workers shall not possess or consume drugs, alcoholic beverages, and/or other controlled substances when on site.
- .9 Wear any required identification badge so that it is in clear view.
- .10 Workers shall not possess firearms or weapons on site.

3.4.10 The Contractor shall be responsible for enforcing the standards of conduct referenced in this Article 3.4.

3.4.11 The Owner shall have the right to have the Contractor remove from the site all workers in violation of the above stated standards of conduct.

3.9 Change Subparagraph 3.5.1 as follows:

- In the second line after "good quality and new" insert "and of recent manufacture."
- Change fourth sentence to read as follows:
"The Contractor's warranty excludes remedy for damage or defect caused by abuse, which is not the responsibility of the Contractor, modifications not executed by the Contractor, or improper or insufficient maintenance or improper operation which is not the responsibility of the Contractor, or normal wear and tear under normal usage."

3.10 Replace Subparagraph 3.5.2 with the following:

"3.5.2 All materials and workmanship shall be guaranteed for a minimum of one year from date of Architect's approval of final payment for the entire Project, except where a longer period is specified in the Contract Documents. Each Contractor shall make good without cost to the Owner any defective portion of the work of which he is notified within one year of that date. Repair or replacement of such defects shall extend to other work damaged thereby. Owner's rights and remedies hereunder shall be in addition to any other rights and remedies which Owner may have pursuant to law or this contract. Owner shall be entitled to all other rights and remedies provided by this contract and by law, in addition to the Warranty rights and remedies set forth in this paragraph."

3.11 Move text of Paragraph 3.6 to new Subparagraph 3.6.1

3.12 Add the following Subparagraphs 3.6.2 through 3.6.5:

"3.6.2 The Contractor shall be aware that the Project Owner is a Pennsylvania tax exempt entity, and that Pennsylvania Sales and Use Tax must be paid for all materials and equipment with the exception of certain Building Machinery and Equipment (BME) as defined in applicable law (PA Act 45 of 1998). The Contractor is solely responsible to determine whether certain purchases within his Contract may be tax exempt for the Project Owner and whether the Owner may benefit from the Contractors reduction of said taxes in the calculation of his bid.

.1 Contractors are encouraged to take advantage of any sales tax exemptions for which the Owner is entitled in computing the bid amount.

.2 Contractors intending to purchase certain BME exempt from sales tax shall recognize that they must submit a Pennsylvania Department of Revenue Sales Tax Exemption Certificate (Form REV-1220) to their supplier(s) in accordance with applicable law, without benefit of the Owner's tax exemption number and/or Federal ID Number (EIN); the form should contain the statement, "Property or services qualify as building machinery and equipment, and will be transferred pursuant to a construction contract to (name of Owner)." The Owner will not provide their tax exemption and/or Federal ID Number (EIN) to any Contractor, subcontractor, material supplier or other entity in assisting in making tax-exempt purchases.

.3 Regardless of whether Contractor has taken advantage of certain BME sales tax exemptions in the calculation of his bid, the Contractor shall be required to submit a signed and notarized "Assignment of Rights Sales / Use Tax Refund" form, as hereafter specified, as well as assist the Owner in filing all of the Petitions for Refund with the Commonwealth's Board of Appeals for taxes paid on tax exempt purchases for the Project.

.4 Contractors shall submit to the Owner a letter identifying all materials purchased exempt of sales tax in their Contract, in order to assist the Owner in seeking any refund on tax exempt items.

3.6.3 Access to Accounting Records: The Contractor shall check all materials, equipment and labor entering into the Work and shall keep such full and detailed accounts as may be necessary for proper financial management under this Agreement, and the system shall be satisfactory to the Owner. The Owner or its representative shall be afforded access to all the Contractor's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and such similar data relating to this Contract, and the Contractor shall preserve all such records for a period of twelve (12) years (Statute of Repose period), or for such longer period as may be required by law, after final payment.

3.6.4 Assignment of Refund Rights: The Contractor hereby assigns and transfers to the Owner all his rights to sales and use tax which may be refunded as a result of a claim for refund for materials purchased in connection with this Contract, regardless of whether Contractor has taken advantage of certain non-taxable Building Machinery and Equipment (BME) in the calculation of his bid. The

Contractor further agrees that it will not file a claim for refund for any sales or use tax which is subject to this assignment.

- .1 Contractor further agrees that he will assist the Owner in the preparation and submission of petitions for refund pertaining to those taxes.
- .2 Contractors shall be required to submit a signed and notarized "Assignments of Rights Sales / Use Tax Refund" form, within the time period specified for initial submittals in Section 011000. Sample form included following these General Conditions.

3.6.5 Contracts with Subcontracts: The Contractor agrees to include the "Access to Accounting Records" and "Assignments of Refund Rights" paragraphs, in full, in any contracts with subcontractors. "

3.13 Replace Subparagraph 3.7.1 with the following:

3.7.1 The Owner or its Agents, shall secure and pay for the building permit. The Owner, at its discretion, may require the Contractor to retrieve approved building permits from the Permitting Authority, and pay for the balance of the permit fee. Any monies paid by the Contractor for the completed permit shall be immediately billable to the Owner without markup or surcharge and upon submission of the permit invoice/receipt.

3.7.1.1 The Contractor shall secure and pay for all other fees and licenses necessary for proper execution and completion of the Work of the Contract and legally required at the time bids are received or negotiations concluded.

3.7.1.2 The Owner shall directly procure third-party services for required inspections unless specifically assigned to the Contractor in the Project Manual."

3.14 Subparagraph 3.7.3 add "or having reason to know" after "knowing" in the first sentence.

3.15 Replace Subparagraph 3.7.4 as follows:

3.7.4 Concealed or Unknown Conditions: If the Contractor encounters conditions at the site that are (1) 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 7 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. The Architect's initial determination shall not be binding upon the Owner. If the Contractor disputes the Architect's determination or recommendation, the Contractor may proceed as provided in Article 15."

3.16 Replace Subparagraphs 3.9.1 through 3.9.3 with the following:

“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.

- .1 The Contractor's Superintendent shall be employed full-time on the Project site during performance of all work under the Contractor's responsibility, including but not limited to, all work performed by Contractor's subcontractors.
- .2 The Contractor's Superintendent shall be supervising / directing work, and not performing work.
- .3 At any time, and without cause, the Owner and/or Architect may request that the Contractor assign a different superintendent to the Project than originally assigned. The assignment of a new superintendent shall be without additional cost to the Owner.

3.9.2 The Superintendent shall be satisfactory to the Owner, and the Contractor shall not replace the Superintendent without the prior written consent of the Owner, which consent shall not unreasonably be withheld.

3.9.3 The Contractor shall furnish a fully qualified and competent project superintendent subject to the approval of the Owner. At a minimum, the superintendent shall have at least ten (10) years' experience of progressive experience as a construction superintendent, five (5) years of which shall be with similar construction.

3.9.4 The proposed superintendent shall possess strong supervisory, project scheduling and management skills and excel in planning and directing complex projects. The proposed superintendent shall be able to analyze plans and specifications to determine that time frame, staffing requirements, and appropriate resources are available for various phases of construction; direct and coordinate all construction activities to maintain optimum efficiency of operations and effectively utilize human resources, machinery and equipment; establish work plans for each construction phase, assign duties, provide technical advice, prepare schedules, and set deadlines to ensure timely completion of work.

3.9.5 The Contractor shall submit the qualifications of the project superintendent to the Owner, and copy the Architect for approval in the form of a resume that shall include a list of major projects, certifications and affiliations. The written qualifications also include a detailed list of training seminars and evidence of certifications/credentials, etc. The Owner also reserves the right to conduct a personal interview of the prospective superintendent, in addition to the above requirements. The Contractor's superintendent shall have full authority to attend of project meetings and make all decisions representing the Contractor on a daily basis and direct work that is either their own or their subcontractors.

3.9.6 Under no circumstances shall work commence on the project site until the contractor's designated project superintendent has been approved by the Owner. If the Owner rejects the Contractor's project superintendent, the Contractor shall submit the name of an alternate superintendent for the Owner's consideration.

3.9.7 The approval of a contractor's project superintendent shall not, under any circumstances, be considered a waiver of the contractor's obligation to perform the work according to the terms of the contract documents.”

3.17 Replace Subparagraph 3.10.1 as follows:

“3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's approval a Contractor's construction schedule for their Work. In accordance with Section 013200 Contractor will submit schedule information to the Architect and be party to the sign off and approval process for the Project Schedule. The schedule shall not exceed

time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project schedule to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. All schedule creation, format, and progress updating shall follow those conditions covered in the "Summary of Work" and "Construction Progress Documentation" specification sections."

3.18 Replace Subparagraph 3.10.2 as follows:

"3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter update it as necessary to maintain a current submittal schedule and shall submit the schedule(s) for the Architect's approval. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals consistent with the time expressly set forth in the contract documents. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals."

3.19 Subparagraph 3.10.3 at the end of the sentence, add "and in accordance with the time limits in the Contract Documents."

3.20 Add the following Subparagraph 3.11.1:

"3.11.1 Throughout the progress of construction, each Contractor shall maintain in good order and marked currently a set of printed Record Drawings, Specifications, Addenda, Change Orders, Construction Change Directives, and other Modifications recording all field changes and selections made during construction, and which are not shown on the Contract Drawings. At the completion of the Project, the set of marked up documents shall be delivered to the Architect in good and legible condition. Changes made to such documents which will be required as Record Drawings shall be noted in a legible fashion using contrasting color markings on a clean set of drawings. Final payment shall not be authorized until completed Record Drawings are submitted to the Architect."

3.21 Add the following Subparagraphs to Subparagraph 3.12.3:

- .1 All materials submitted as samples shall be properly labeled and delivered to the Architect's office. Materials will be examined by the Architect and, if approved, will be signed, dated and delivered to the project site. Approved samples shall remain on the project site for use in checking the material or equipment incorporated in the work.
- .2 In instances where materials will affect the color planning of the work, samples of the colors will be submitted for approval and selection by the Architect within the time period specified for Submittals in Section 0011000.
- .3 Samples of materials which the Architect deems necessary to be tested shall be submitted in duplicate to approved testing laboratories. The Architect's decision as to those materials requiring laboratory testing shall be final. The Contractor shall prepare and forward to testing laboratory all materials requiring testing, shall pay for all expenses involved in connection thereof and shall cause the testing laboratory to forward the results directly to the Architect."

3.22 Append to Subparagraph 3.12.7 the following:

"Such work shall be in accordance with the reviewed submittals."

3.23 Delete from Subparagraph 3.12.8 the following:

"The Work shall be in accordance with the approved submittals except that the"

3.24 Add the following Subparagraph 3.12.8.1:

“1 The Contractor’s obligations are not changed by an approval of any shop drawing or other submittal. If the contractor intends that a change to the Contract be made by any information in a shop drawing, he will affirmatively state that the shop drawing depicts a change in the work and will submit a written request for change order in sufficient time for the Architect to understand that a change order is being requested before the time the Architect’s approval of the shop drawing is required. No notation, mark or other comment by the Architect on a submittal or in a response to a Request for Information shall constitute a change in the Contract. If the Contractor asserts that any notation, mark or comment by the Architect contained in a submittal or response to a Request for Information will change the Contract, the contractor will immediately follow the procedures set forth in paragraph 15.1 to request and pursue a change in the Contract.”

3.25 Add the following Subparagraph 3.13.3:

“**3.13.1** Only materials and equipment which are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. Materials or equipment no longer required for the Work shall be promptly removed from the Project site. Protection of construction materials and equipment stored at the Project site from weather, theft, damage, or all other adversity is solely the responsibility of the Contractor, unless specifically noted otherwise by Owner.”

3.26 Add the following Subparagraph 3.13.4:

“**3.13.3** The Contractor shall be responsible for damages to roads, parking lots, lawns or other features of the grounds or adjacent to the Project site resulting from driving, hauling, storage of materials or other construction activities and shall repair any such damage to match the condition prevailing prior to such damage. The Contractor will be required to provide a bond for all Municipal and or State roads and bridges as deemed by the Owner.”

3.27 Add the following Subparagraph 3.16.1:

“**3.16.1** Representatives of governmental agencies shall have access at all reasonable times to inspect the Work, and the Contractor shall provide proper facilities for such access and inspection.”

3.28 Add the following Subparagraph 3.16.2:

“**3.16.2** Job conferences will be held while construction is in progress. Contractor’s representative shall be in attendance. The Contractor shall cause a representative of all Sub-contractors designated by the Architect also to be in attendance. All such representatives shall have such authority as is necessary to bind their respective Principals. The schedule of conferences shall be determined by the Architect. At the job conferences all representatives shall be prepared to state the amount of their respective portion of work completed during the previous work period and what portion is scheduled to be undertaken during the upcoming work period. Contractor’s reports shall reference the corresponding dates and anticipated work itemized on the reviewed comprehensive construction schedule. Problems of coordination and clarifications shall be reviewed and discussed at the conferences. Failure by the Contractor to provide such representation shall result in the Architect withholding monies from that Contractor’s Monthly Application for Payment and/or withholding certification of the entire monthly application for payment.”

3.29 Replace Subparagraph 3.18.1 with the following:

“**3.18.1** To the fullest extent permitted by law and to the extent claims, damages, losses or expenses are not covered by insurance supplied by either the Owner, the Contractor, or the Subcontractors as required by Article 11 of this Contract,, the Contractor shall indemnify, defend (at Owner’s request and through counsel reasonably acceptable to Owner) and hold harmless the Owner, Architect, Architect’s consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys’ fees, and defense costs, arising out of or resulting from performance of the Work to the extent caused in whole or in part by the acts or omissions of the Contractor, a Subcontractor, anyone directly or

indirectly employed by them or anyone for whose acts or omissions they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge or reduce other rights or obligations of indemnity which would otherwise exist. The Contractor agrees to and does hereby assume on behalf of the Owner and Architect the defense of any action at law or in equity which may be brought against such indemnified parties by reason of claims for which indemnification is owed hereunder, and will pay on behalf of such parties, upon their demand, the amount of any judgment that may be entered against any of them in any such action. In the event that any claim, loss, cost, expense, liability, damage or injury arises or is made, asserted, threatened against the Owner for which the Contractor or its insurer does not admit coverage, or if the Owner reasonably determines such coverage to be inadequate, the Owner shall have the right to withhold from any payments due or to become due to the Contractor an amount sufficient to protect the Owner from such claim, loss, cost, expense, liability, damage or injury, including attorneys' fees and expenses reasonably necessary for the defense thereof."

3.30 Add the following Paragraphs and Subparagraphs 3.19 through 3.23:

3.19 Sanitary Provisions

3.19.1 The General Contractor shall provide and maintain sanitary provisions (temporary toilet facilities) as specified in Section 015000 (Temporary Facilities and Controls).

3.20 Temporary Utilities (Water, Electric, Heating and Ventilating)

3.20.1 Refer to Section 015000 (Temporary Facilities and Controls).

3.21 Maintaining Existing Systems

3.21.1 Refer to Section 015000 (Temporary Facilities and Controls).

3.22 Field Offices and Sheds

3.22.1 Refer to Section 015000 (Temporary Facilities and Controls).

3.23 Blasting

3.23.1 No blasting shall be performed on the Project Site.

4.1 Add the following Subparagraph 4.1.4:

"4.1.4 If the employment of the Architect is terminated, the Owner shall employ a successor architect whose status under the Contract Documents shall be that of the former Architect, respectively."

4.2 Change Subparagraph 4.2.3:

In the first sentence, replace the text "whenever the Work is being performed" with "at a frequency and duration per the terms of its agreement with the Owner."

4.3 Delete Subparagraph 4.2.4

4.4 Change Subparagraph 4.2.5:

In the first sentence, delete ", except to the extent required by Section 4.2.4,"

4.5 Add the following Subparagraph 4.2.15:

"4.2.15 For incidental items only, the Contractors agree to comply with field orders or instructions of the Architect, or additional detail drawings reasonably consistent with the Contract Documents, without claiming extra compensation or time extension."

5.1 Add the following Subparagraph 5.1.3:

"5.1.3 A Supplier is a person or entity who has a direct or indirect contract with the Contractor, Subcontractor or Sub-subcontractor to furnish materials or equipment for the Work. The term "Supplier" is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Supplier or an authorized representative of the Supplier."

5.2 Replace Paragraph 5.2 and its Subparagraphs with the following:

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

5.2.1 The Contractor shall furnish in writing to the Owner through the Architect (1) the name, trade, and subcontract amount for each subcontractor, (2) the names of all persons or entities proposed as manufacturers of the products identified in the specifications (including those who are to furnish materials or equipment fabricated to a special design) and, where applicable, (3) the name of the installing subcontractor, on "Material Source of Supply" form as included following these General Conditions and as provided by the Architect. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity or, (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14-day period shall constitute notice of no reasonable objection.

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

5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. The Contract sum shall be unchanged as a result of any such substitutions.

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

5.2.5 The Contractor shall not contract with subcontractors for more than 85% of the Contractor's Work for this Project. A minimum of 15% of the Contractor's Work must be completed by the Contractor.

.1 100% of a sub-contract must be completed by the sub-contractor's own employees; labor sub-contracts shall not be sub-sub-contracted."

5.3 Replace Paragraph 5.3 and its Subparagraphs with the following:

5.3 Subcontractual Relations

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

agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

5.3.2 Contractor must include all provisions of this contract in its Subcontractor agreements binding its subcontractors to the same extent the Contractor is bound herein. In addition, Contractor must specifically insert (and not just incorporate) provisions requiring the Contractor's subcontractors to indemnify, hold harmless and defend the Owner, Architect, and their consultants, administrators, officers and employees to the same extent the Contractor is bound by the Contract.

5.3.3 Except as may be otherwise provided in these General Conditions, Sub-Contractors may make claims only against Contractor with whom the Sub-Contractor has entered into an agreement to perform work.

6.1 Replace Subparagraph 6.2.3 with the following:

"6.2.3 The Owner and Architect shall not be liable for losses, damages, costs or delays suffered by the Contractor arising from any action or omission of any other Contractor, including defective work, interference, failure to properly schedule and coordinate the Work or failure to diligently perform its scope of work. If a Contractor, its agents, servants, employees or sub-contractors, including the sub-contractor's agents, servants, or employees, cause damage to the property or Work of another Contractor, cause delay or interference to any other contractor/subcontractor or cause any other additional expense or damage, the Contractor/subcontractor shall make claims only against such other Contractor/subcontractors who was or were the cause of such expense or damage in whole or in part, and shall settle by agreement or, if unable to settle, by binding arbitration by filing such unresolved claim with the American Arbitration Association pursuant to the Construction Industry Arbitration Rules then in effect. The Contractor agrees that such disputes will not delay the project. The Contractor acknowledges and agrees that neither the Owner nor the Architect shall be a party to such claim or dispute between the Contractor/subcontractors, even if the Owner or Architect were in part to blame for such damage. The Contractor also acknowledges and agrees that the rights of the Owner to withhold payment to the Contractor, or to demand compliance by the Contractor with the terms of the Owner's contract with the Contractor are rights of the Owner, and that the Owner is not required to take advantage of or act upon its rights for the benefit of the Contractor. In addition, failure of the Owner to take advantage of or act upon its rights under the contract shall not constitute active interference of the Owner. It is agreed that the intent of this subparagraph is to create a right of action for the benefit of the Contractor on the Project to the extent described hereinabove. The Contractor agrees that the right of action contained in this subparagraph is provided as valuable consideration to the Contractor, and the Contractor, acknowledges and agrees that claims against the Owner and Architect for damages resulting from other Contractors and/or his subcontractors, as described hereinabove, are hereby prohibited."

7.1 Add to Paragraph 7.2 the following:

".4 No work shall be performed until Change Orders have been issued and signed as per Change Order requirements, except in case of emergency as described in Article 10, subparagraph 10.6.1, in such case the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss."

7.2 Add the following Subparagraph 7.2.1:

"7.2.1 The allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the schedule contained in Clauses 7.3.11.1 through 7.3.11.5."

7.3 Add the following Subparagraphs 7.2.2:

“7.2.2 Methods used in determining adjustments to the Contract Sum may include those listed in Section 7.3.3. The Contractor represents that any change order agreed between the Owner and Contractor on this project will include all costs associated with the additional work described in the change order, including all costs of associated delay, acceleration, inefficiency and overhead, as well as costs of material, labor and supervision. To the extent that any request for change order or correspondence prior to the signed change order is contrary to this paragraph, such requests or correspondence shall have no effect.

.1 The Contractor represents that it has the skills, expertise and cost accounting programs and/or tools necessary to maintain a record of all costs associated with any change in the work and that it will maintain a complete record of all costs associated with a change at the time such costs are incurred. The Contractor will create a cost item in its cost recording system for each change for which it intends to request a change order. At the time the Contractor requests a change order, it will identify the cost reporting reference number and will provide all supporting documentation maintained by the Contractor for all labor and material costs, including certified payroll, invoices, record of equipment costs and costs for overhead, supervision and tools. The Contractor will update its cost system as necessary to capture all costs associated with a change in the work and will regularly update the Owner as costs are incurred for which it desires to be paid. Once a change order is issued for a change in the work, the contractor shall not be entitled to any other costs or damages, including but not limited to any costs for inefficiencies, delays, or other costs, that result from the change in the work. The Contractor will provide the information required of this provision in strict accordance with the change order provisions of this contract and acknowledges that the Owner and Architect have a right to rely on the Contractor's strict compliance, including compliance with time requirements such that the Owner and Architect have an opportunity to minimize the costs associated with the change request by timely submission of the information required under this paragraph. The intent and requirement of this paragraph is for the contractor to provide all facts, analysis and evidence of this claim as early as is practicable so that the Owner has the opportunity to minimize damages and fully evaluate the contractor's claim without incurring litigation costs. The Contractor shall not reserve rights to damages or present claims for damages or evidence of damages at any arbitration or trial that were not presented to support its Change Order request and Notice of Claim documentation. It is material to this contract that the Owner and Architect be given an opportunity to review the totality of the evidence the Contractor intends to present in connection with any change order request at the time the change order request is being considered.

a. The failure of the Contractor to maintain and provide labor and cost accounting documentation in support of any claim shall constitute a waiver of any entitlement to costs not substantiated in compliance with the provision. Contractor shall be barred from introducing at any arbitration or trial upon any claim against the Owner any evidence of alleged damages that was not generated and maintained in compliance with this provision.

.2 Payment of a change order shall constitute accord and satisfaction of all claims in connection with the change or changes to the Contract addressed by the change order, and it is understood and agreed that a signed change order form shall be the complete and fully integrated agreement for all related costs and that there are no oral or written understandings, representations or agreements, directly or indirectly, connected with the Change Order that are not affirmatively stated on the signed Change Order form. The contractor's execution of a change order constitutes a representation that it will make no further claims for damages inconsistent with this paragraph.

.3 If additional time is required as part of a change, the cost impact where additional costs are permitted under a specific section of the contract documents shall be included in the Contractor's overhead and profit. There shall be no additional contract time if the change order states "0" days is added to the Contract."

7.4 Change clause 7.3.3.1 as follows:

Add at the end, "and with an allowance for overhead and profit in accordance with the schedule set forth in Subparagraph 7.3.11."

7.5 Change Subparagraph 7.3.4 as follows:

In the first sentence, delete the words "an amount for overhead and profit ... a reasonable amount." and substitute "an allowance for overhead and profit in accordance with the schedule set forth in Subparagraph 7.3.11."

7.6 Add the following Subparagraph 7.3.11:

"**7.3.11** In Clause 7.3.3.1 and in Subparagraph 7.3.4, the allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the following schedule:

1. For the Contractor; for any Work performed by the Contractor's own forces, fifteen percent (15%).
 - a. Labor costs shall include the certified Base Prevailing Wage Rate (or the base wage rate if the Prevailing Wage Act is not applicable to the Project), plus actual fringe benefits per wage determination plus 25% for FICA, SUTA, FUTA, and Worker's Compensation. No costs beyond those listed will be considered. Total labor cost for the Contractor's employees shall be this cost plus a mark-up of 15% for overhead and profit. This mark-up includes all overhead, including supervisory personnel, estimators, staff, office time, etc.
 - b. Material, Supplies, and Equipment costs shall be the invoice cost, plus sales tax (if applicable), plus a mark-up of 10% for overhead and profit.
 - c. Bonds and Insurance costs shall be submitted without mark-up.
2. For the Contractor, for work performed by his Subcontractor or material supplier, five percent (5%) of the amount due to the Subcontractor.
 - a. Subcontractor Labor invoice for hourly wages and materials costs shall be in accordance with the definitions listed above.
3. For each Subcontractor or Sub-subcontractor involved, for any Work performed by that Contractor's own forces, fifteen percent (15%) of the cost.
4. For each Subcontractor, for Work performed by his Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractor.
5. Cost to which overhead and profit is to be applied shall be determined in accordance with Clauses 7.3.4.1 through 7.3.4.5."

7.7 Add the following Subparagraph 7.3.12:

"**7.3.12** In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and subcontracts. Labor and materials shall be itemized in the manner prescribed above; labor costs shall be actual costs (wages and benefits), not standardized billing rates and shall be limited to the items listed in .1 below. Where major cost items are subcontracts, they shall be itemized also. In no case will a change involving over \$500.00 be approved without such itemization."

1. Costs of Labor shall be subject to the limitations listed in 7.3.11.1(a) of the Supplemental Conditions of the Contract.

8.1 Change Subparagraph 8.1.3 as follows:

After "Architect" insert "and approved by the Owner."

8.2 Add the following Subparagraph 8.1.3.1:

"**.1** There is intended herein to be a differentiation between "Substantial Completion" and "Final Completion." Substantial Completion is as defined in Paragraph 9.8.1 Final Completion shall be when the Contract is fully performed, including all Punch List items, and all close-out documents and procedures submitted, completed and accepted by the Owner."

8.3 Add the following Subparagraph 8.2.1.1:

"8.2.1.1 Any preliminary schedule, if provided, is for information purposes only and constitutes a proposed sequence of events based on standard practices. Bidders shall not rely on dates or durations suggested by this schedule. The Contractors are responsible to provide the Architect a detailed Construction Schedule of their work within fifteen (15) business days after the date of written notice of Bid Award and a Construction Progress Schedule will be developed and updated periodically. The Architect shall be notified of all proposed changes to the Construction Schedule. All revisions to the Initial Construction Schedule that has been compiled by the Project Coordinator and agreed upon by all Prime Contractors, shall require approval by the Architect."

8.4 Add the following Subparagraph 8.2.4:

"8.2.4 Extraordinary Measures. In the event the Owner, after consultation with the Architect, determines that the performance of the Work has not progressed or reached the level of completion required by the Contract Documents and the Project construction schedule, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, but not limited to, working additional shifts or overtime; supplying additional manpower, equipment, and facilities; and other similar measures (referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the Project construction schedule and failure to comply shall be considered as breach of the Contract Documents. The Contractor shall not, under any circumstances, be entitled to an adjustment in the Contract Sum in connection with Extraordinary Measures required by Owner under or pursuant to this Paragraph **8.2.4.**"

8.6 Add the following Subparagraph 8.2.6:

"8.2.5 If low temperatures make it impossible to continue operations safely by use of cold weather precautions, the Contractor shall cease work and notify the Architect, and Owner by letter. When work is resumed the Contractor shall notify, by letter, the Architect and Owner. Such stoppage shall not constitute an extension of the completion date."

8.7 Delete Subparagraph 8.3.1 in its entirety and replace with the following:

"8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner, Owner's own forces, Architect, or an employee of any of them, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

.1 No Change Order extending the Contract Time shall result in any increased payments to the Contractor for extended overhead, delay damages, "impact" damages, loss of efficiency, loss of productivity or any other similar form of loss, damage or compensation.

.2 No payment or compensation or claim for damages shall be made to the Contractor as compensation for damages for any delays or hindrances from any cause whatsoever in the progress of the work, notwithstanding whether such delays be avoidable or unavoidable. The Contractor's sole remedy for delays shall be an EXTENSION OF TIME ONLY, pursuant to, and only in accordance with this Paragraph 8.3, such extension to be a period equivalent to the time lost, day for day, by reason of any and all of the aforesaid causes, as determined by the Architect. In consideration for this grant of time extension, the Owner and/or Architect shall not be held responsible for any loss or damage, or increased costs sustained by the Contractor through any delays caused by the Owner or Architect or any other Contractor or on account of the aforesaid causes or any other cause of delay. In the event the Contractor shall choose to litigate this clause or issue and the Contractor is not the substantially prevailing party in said litigation, the Contractor shall reimburse the Owner and the Architect for their reasonable attorney's and expert witness fees and all other costs and expenses incurred by them in the litigation. "Substantially Prevailing"

shall mean that the Contractor recovers an award that is at least 50.1% of the damages that the Contractor has alleged it is entitled to in the litigation.”

8.8 Add the following Subparagraph 8.3.2.1:

“8.3.2.1 Requests for extension of Contract Completion Date shall be submitted in writing to the Owner and the Architect not more than seven days after the commencement of the delay, otherwise, it shall be waived. This request shall contain at a minimum the following information: 1) date of start of delay; 2) specific cause of delay; 3) effect of delay on construction progress; 4) date of termination of delay; 5) a schedule analysis reflecting the impact of the delay on critical path activities; 6) statement of bonded surety concurring in request for extension of Contract Completion Date and the Agreement to extend coverage for the requested extension; 7) evidence of notification of this request having been given to all Contractors engaged on the project and their concurrence to such extension of time.”

8.9 Replace Subparagraph 8.3.3 with the following:

“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. To the extent that Contractor may be entitled to damages under other provisions of the contract documents for delay, interference, inefficiency or lost productivity, such damages shall be submitted in the Contractor’s request for Change Order or Notice of Claim to be included in an appropriately executed Change Order granting an extension of time for such delay. The legitimate right to such damages shall be verified by affidavit and submitted with appropriate backup information to support any such amount. Contractor acknowledges that it is not entitled to damages for delay in any amount other than the damages agreed to as part of the Change Order. To the extent that a Change Order cannot be agreed to, Contractor shall submit a claim in accordance with the provisions of Article 7. For any such claim that is submitted, Contractor acknowledges that it is not entitled to any amount greater than the verified amount submitted in its request for a Change Order.”

8.10 Add the following Subparagraph 8.3.4:

“8.3.4 Damage Claims for Delays Caused By Contractors, Subcontractors and Suppliers or any Employees thereof:

.1 The Owner is not responsible for delays caused by any Contractor and/or Subcontractor. The Owner is not responsible for problems caused by the failure of a Contractor to coordinate its work with other Contractors and/or Subcontractors. The Owner is not liable for any damages suffered by a Contractor arising from any Subcontractor’s delays and/or failure to coordinate its work. Contractor hereby waives and releases the Owner from any liability and damages caused by lack of coordination by the Contractor, or between or among the Subcontractors, including their suppliers.

.2 The Architect and the Owner and their representatives shall not be liable to a Contractor for any increased costs or damages for defective work, interference, or delays resulting from any conflict between or among the Subcontractors, and suppliers. Neither the Owner nor the Architect shall be a party to disputes or actions between or among the Contractor or his subcontractors and suppliers concerning such additional expense or damage.

.3 It is agreed by all parties that disputes or actions between the Contractor and his subcontractors concerning any additional expense or damage herein before mentioned shall not delay completion of the Work, which shall be continued by the parties pending final resolution of a claim including judicial proceedings.

.4 The Contractor hereby waives privacy of contract defenses and agrees that subcontractors have the right to file claims in a binding arbitration with the American Arbitration Association pursuant to the Construction Industry Arbitration Rules then in effect against the Contractor in the event Contractor is alleged to have caused damages to subcontractors by reason of delay or lack of coordination. Neither the Owner nor the Architect shall be a party to such Arbitration.

.5 It is agreed by the parties to this Contract (the Owner as promisee and the Contractor as promisor) that the intent of this Section 8.3.4 is to benefit the other and is the mutual intents of the Owner and the Contractor that this Section 8.3.4 raises the Contractor to the status of third-party

beneficiary only as to the terms and conditions of Section 8.3.4. The Contractor agrees that Section 8.3.4 is provided as a benefit to the Contractor and that the Contractor specifically excludes, releases, foregoes and waives any claims against the Owner or the Architect for extended overhead, delay damages, "impact" damages, loss of efficiency, loss of productivity, or any other similar form of loss, damage or compensation, or other damages related to any delays whatsoever or from any amendment to the Construction Schedule."

8.11 Add the following Subparagraph 8.3.5:

"8.3.5 Liquidated Damages:

.1 The work to be performed under this Contract shall be commenced and substantially completed as set out in the Agreement Between Owner and Contractor, or by dates thereafter as may be established in any written extensions granted under Article 8 of the General Conditions. The parties hereto agree that time is of the essence of this contract and that there are pecuniary damages which could be suffered by the Owner, if the Contractor does not complete all work called for in the contract documents by the specified date,

.2 It is therefore expressly agreed as part of the consideration inducing the Owner to execute this contract that the Owner may deduct from the final payment made to the Contractor a sum equal to a certain amount per day, as stipulated hereinafter, for each additional calendar day beyond the agreed date which the Owner shall require for Substantial Completion of the work included in this contract. It is expressly understood that the sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the work is not completed within the agreed upon time, or within the legally extended time, if any, otherwise provided herein. Said sum shall be considered liquidated damages only and in no sense shall be considered a penalty, said damage being caused by additional compensation to personnel, for loss on interest of money and other miscellaneous increased costs or costs incurred by Owner as a result of the work not being completed by the stipulated date of Substantial Completion.

.3 Liquidated Damages for this project are in the amounts that follow at a rate per each additional calendar day beyond the agreed to date which the Owner shall require for Substantial Completion, the latter of **10 months from date of Notice to Proceed or October 31, 2025:**

- a. **\$200 per day for Days 1-30**
- b. **\$1,000 per day beyond day 30.**

9.1 Replace Paragraph 9.2 as follows:

"Within fifteen (15) days, the Contractor shall submit to the Architect on the form required by the Architect, a Detailed Cost Breakdown of scheduled value of all items of work entering into the Contract. This detailed breakdown will show quantities of the respective items and the allowance for labor, material and other costs entering into each item including line items to process submittals, schedule production and close-out documents as applicable. The detailed breakdown, when approved by the Architect, shall be used as a basis by the Contractor in preparing monthly estimates for payment and shall, as accurately as possible, reflect the true division of costs of the respective items entering into the Contract. Failure of the Contractor to submit Detailed Cost Breakdown by the date specified shall result in Architect's not approving Contractor's application for payment that month.

9.2 Replace Subparagraph 9.3.1 as follows:

"9.3.1 At least fifteen (15) days before the date established for each progress payment (as determined at the Initial Job Conference), the Contractor shall submit to the Architect an itemized

Application for Payment prepared in accordance with the schedule of values, as required under Section 9.2, for completed portions of the Work. Such application shall be notarized and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers and shall reflect retainage provided for in Paragraph 9.3.1.3.

- a. Applications shall be submitted using Architects document management platform or by other means specified by Architect.
- b. Submittals of all Color Selectors/Samples, Shop Drawings, etc., shall be submitted to the Architect in a timely fashion to allow for a minimum of ten (10) days review without impact to the project schedule. Should any of these items remain outstanding, no further payments will be processed."

9.3 Add the following Subparagraph to Subparagraph 9.3.1.2:

“.1 Contractor shall submit with the Application for Payment each month, a Sworn Statement stating that the Contractor has paid all Subcontractors of whatever tier who have performed Work or provided equipment and materials for the Project in the full amount to which the Subcontractors are entitled to date and waives any right that the Contractor, his subcontractor, and/or his suppliers have to file a Mechanic's Lien for the work, material and/or supplies provided to date."

9.4 Add the following Subparagraphs 9.3.1.3 through 9.3.1.6:

“9.3.1.3 Estimates for payment Documents will require breakdown of the total work completed to date of submission. From this total will be deducted a ten percent retainage. From the resultant amount will be deducted all previous payments. At such time that the Contractor determines that 50 percent of the work has been completed the Contractor shall notify the Owner, Architect and the Contractor's Surety in writing of this fact and upon each addressee's approval, retainage shall be reduced from 10% to 5% unless the Contractor is not making satisfactory progress, or unless there is specific cause for greater withholding. The retained five percent will be processed for payment on the issuance of the Certificate of Substantial Completion, unless amounts are withheld as otherwise provided in this agreement.

9.3.1.4 Should the Architect at any time during the progress of the work, consider the amount withheld on Monthly Estimates for Payment to be in excess of the amount necessary to complete the work, or necessary for the full and ample protection of the Owner, then the Contractor may reduce the percentage retained to an amount sufficient for the Owner's proper protection, as approved by the Architect. Should the Architect, at a later date, consider the amount withheld insufficient to protect the interest of the Owner, the Architect may increase the retained percentage to an amount not to exceed ten percent, or five percent, dependent upon the stage or percentage of contract completion.

9.3.1.5 The Architect/Engineer shall make final inspection within 30 days of receipt of the Contractor's written request for final inspection. If the work is substantially completed, the Architect/Engineer shall issue a Certificate of Substantial Completion. As per Section 9.10, regarding Contractor's initial Application for Final Payment, the Architect/Engineer shall issue a Certificate for Payment, less one and one-half times the amount required to complete any then remaining, uncompleted, punch list items and the value for all incomplete close-out processes and document submission, which amount shall be certified by the Architect/Engineer and upon receipt by the Owner of any guarantee bonds which may be required, in accord with the Contract Documents, to insure proper workmanship for a designated period of time, the Owner shall make payment within 45 days thereafter. The certificate given by the Architect/Engineer shall list each uncompleted item and a reasonable cost of completion. Final payment of any amount withheld for the completion of the minor items shall be paid upon completion of the items with submission of the

Final Application for Payment in accordance with Section 9.10. Any amounts withheld under this Paragraph are in addition to any amounts withheld under Paragraph 9.3.1.5.

9.3.1.6 The cost of preparation of shop drawings and related information shall not be included in submission for payment until substantial quantities of materials are on the project site.”

9.2 Replace Subparagraph 9.3.2 with the following:

“9.3.2 Materials in reasonable quantities, which are delivered to the site, properly stored, and accepted for incorporation in the work but not yet so used, may be included in Monthly Estimates for Payment. The Contractor shall submit with the Monthly Estimate reflecting the unincorporated material the following:

.1 The original and two (2) copies of itemized, paid invoices showing payment of such material by the Contractor and delivery slips certifying to the delivery of the quantities set forth on the estimate to the site of the work.

.2 Payment for materials stored on the site shall be based on actual cost for same as shown by the receipted invoices and shall not exceed the cost of materials as indicated on the approved Detailed Cost Breakdown for the particular items involved.

.3 The receipted invoices shall have each item identified and marked with the Contractor's corresponding itemized breakdown number.

.4 Provide Insurance Certificates in the full amount of the materials against theft, loss from any other cause, damage, destruction and/or such other risks as may be involved, which would render the aforesaid materials unfit or unavailable for incorporation in the work.

.5 Provide current photos of the labeled stored materials.

.6 Provide a letter on company letterhead signed by a company officer stating that all material and equipment become the legal property of the Owner upon receipt of payment.

.7 Statement from the Contractor's Surety Company acknowledging stored materials are being paid and there is no objection.

.8 Request for payment for materials stored off site, in addition to the above requirements, shall include a statement identifying the location of said materials. The Owner and the Architect, or their representatives, shall have full access to the location of said materials.

.9 The Contractor shall mark or identify such materials as being the property of the Owner and shall be solely responsible for their safe keeping and usability at the time it is to be incorporated in the work and shall at his own expense care for and protect the same.

.10 The Contractor shall submit the “Contractor's Request for Stored Material Payment” form, included following these General Conditions, with each request for stored material payment. Failure to submit the form and verification attachments will result in denial of the request.

9.3.2.1 In addition to specific items listed in Subparagraph 9.3.2 above, payment may be requested by the Contractor for the following items which shall be identified and included as separate line items in the Schedule of Values.”

9.3 Change Subparagraph 9.5.1

At the end of the first sentence insert “, and the Owner may disapprove a Certificate for Payment for the same reasons.”

9.4 Delete Subparagraph 9.5.2

9.5 Add to Subparagraph 9.6.1 the following:

“.1 To the extent allowed by law, Contractor waives any entitlement to interest, penalties and attorneys' fees under the Commonwealth Procurement Code.”

9.6 Replace Subparagraph 9.6.2 with the following:

“9.6.2 In accordance with 62 Pa. C.S.A. Section 3922: In the absence of good and sufficient reasons, within 20 days of the receipt of payment by the Contractor, the Contractor shall pay all subcontractors with whom he has contracted their earned share of the payment the Contractor received. The Owner or Architect Manager may, as a pre-condition to payment, require proof of payment to subcontractors, sub-subcontractors, and suppliers at any time and from time to time.”

9.7 Change Subparagraph 9.8.1 as follows:

In the second line, change “occupy or utilize” to “occupy and utilize.”

9.8 Add the following Subparagraph 9.8.3.1:

“9.8.3.1 The Owner may deduct from the Contract Sum any additional fees paid by Owner to the Architect due to the necessity of re-inspection(s).”

9.9 Replace Subparagraph 9.8.4 as follows:

“9.8.4 When the Architect determines that the Work or designated portion thereof is substantially complete, the Architect will prepare and execute a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate along with a deadline date by which all punch work and close-out processes/submissions shall be completed.

.1 Warranties required by the Contract Documents shall commence on the date of Substantial Completion for the Entire Project.

9.10 Change Subparagraph 9.9.1 as follows:

Insert prior to the first sentence: “The Contractor shall complete any portion or portions of the work in such order as may be stated in the Contract Documents. All work shall be so arranged and Contractors shall so coordinate their work as to complete the work by date set forth in the Contract as applicable.”

9.11 Replace all Subparagraphs in Paragraph 9.10 with the following:

9.10.1 The Contractor, when the work is considered complete and accepted by the Architect, shall submit to the Architect a written certification that:

- .1** Contract Documents have been reviewed.
- .2** Work has been inspected and completed in accordance with the Contract Documents.
- .3** Equipment and systems have been tested and operated in the presence of the Owner's representative.
- .4** Work is completed and ready for final review including the submission of all final record prevailing wage labor records, all close-out documents and the completed final cleaning for the site and buildings.
- .5** Request that the Architect make a review to verify the status of completion with reasonable promptness after receipt of such request.

9.10.2 Should the Architect consider that the work is incomplete or defective:

- .1** The Architect will notify the Contractor in writing listing the incomplete or defective work.
- .2** The Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the Architect that the work is complete.
- .3** The Architect will again review the work.

9.10.3 Should the Contractor fail to perform its Work in accordance with the Contract Documents, fail to timely achieve Final Completion or request multiple reviews by the Architect to determine Final Completion causing the Owner to incur expenses for additional compensation to the Architect, such expenses shall be deducted from the Contract Sum.

9.10.4 Following Substantial Completion, in the event the Contractor or its subcontractor fails to complete the list items of the work instructed by the Architect to be corrected or completed within 30 days after the date of Substantial Completion, the Owner may (1) exercise any available remedies to correct or complete deficient work or retain a third party to correct or complete such work at the cost of the defaulting contractor, or (2) retain and deduct amounts as set forth in Section 017000 "Project Closeout Procedures." The Owner may retain and deduct from any payments or retention

otherwise due to the defaulting Contractor any fees and expenses for services required to be provided by the Architect more than 30 days after the specified Completion Date."

9.10.5 When the Architect finds that the work is acceptable under the Contract Documents, the Architect shall request the Contractor to make closeout Submittals:

- .1 Evidence of compliance with requirements of governing authorities.
- .2 Bound and indexed Operation and Maintenance Manuals, including all extended Warranties issued by Contractors and/or manufacturers.
- .3 Record Drawings incorporating As-Built Revisions to drawings and/or specifications, including change orders. Accuracy of As-Built shall be certified by the Contractor as specified in Section 017700.
- .4 Contractor's Affidavit of Payment of Debts and Claims, A.I.A. Document G706.
- .5 Contractor's Affidavit of Release of Liens, A.I.A. Document G706A.
- .6 Consent of Surety Company to Final Payment, A.I.A. Document G707, with effectively dated powers of attorney attached.
- .7 Application and Certification for Final Payment, A.I.A. Documents G702 and G703.
- .8 Evidence of the final certification and submission of the record prevailing wage labor sheets
- .9 Evidence, confirmed by the design professional, that all record punch list work has been completed.
- .10 Evidence, confirmed by the owner, that all work areas have been brought to an acceptable clean status and that all of the contractor's excess material, equipment and other debris has been completely removed from the project site.
- .11 Evidence, through the final submission of the final release of liens, that all financial obligations to all third-party vendors and subcontractors have been met and that all other open changed conditions, claims or other previously open schedule or cost claims are null and void

9.10.6 Final payment shall be based upon full completion of the Project. The final payment shall not be due and payable until the Contractor's satisfactory completion of the requirements listed under final review above. Final payment to the Contractor shall not relieve any Surety of its obligation to the Owner as set forth in the Surety Bonds.

9.10.7 Where one or more claims against the Contractor, which are in controversy appear unsatisfied, the Architect shall have the discretion to direct final payment to be made, or a partial payment to be made from the monies due, should it be determined that the withholding of the entire final payment would work a hardship on the Contractor or delay the final payments required under this paragraph. The Contractor shall itemize the claims which remain unsatisfied, giving the reason therefore, and the statements of the Surety Companies shall provide that the final payment, or partial payment, as the case may be, shall not relieve any Surety of any obligations to the Owner as set forth in the Surety Bonds. If only partial payment is permitted under this paragraph, the final payment shall not be made until the Contractor shall have furnished satisfactory evidence and a statement from the Surety that all claims against the Contractor have been paid and that payment to the Contractor of the Contract balance shall not relieve the Surety of any of its obligations to the Owner as provided in the Surety's Bond.

9.10.8 The acceptance by the Contractor of the final payment shall be and shall operate as a release to the Owner and every member and agent thereof from all claims and all liability to the Contractor for all things done or furnished in connection with this work and for every act and neglect of the Owner and others relating to or arising out of this work. No payment, however, shall operate to release the Contractor or the Contractor's Sureties from any obligations under this Contract or the Performance and Payment Bond."

10.1 Add Subparagraph 10.2.9 as follows:

"10.2.9 The Contractor shall:

1. Take every precaution to secure the Owner's property from theft or vandalism due to Contractor's operation.
2. Comply with orders of fire authorities, include the Owner's fire insurance company, and provide adequate fire protection equipment at site; cost of such compliance to be included in the cost of the Work."

10.2 Replace Subparagraph 10.3.2 as follows:

"10.3.2 Upon receipt of the Contractor's written notice, unless otherwise required by the contract documents, the Owner shall obtain the services of a licensed laboratory to verify a 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. When the material or substance has been rendered harmless, Work in the affected area shall resume, with Contract adjustments, if any, accomplished as provided in Article 7."

10.3 Delete Subparagraph 10.3.3

10.4 Delete Subparagraph 10.3.6

10.5 Add to Paragraph 10.4 the following Subparagraph:

"10.4.1 In an emergency situation, all NESHAP regulations published on November 20, 1990, will be followed. Violators of the NESHAP regulations will be subject to significant fines and enforcement action from EPA, as well as the applicable State or Local air agencies."

1.56 Delete Article 11 in its entirety and replace with the following Article and Subparagraphs:

"ARTICLE 11 INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

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

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

11.1.1.1 Liability Insurance shall include all major divisions of coverage and be on a comprehensive basis including:

1. Premises Operations (including X-C/U coverages).
2. Products and Completed Operations.
3. Personal Injury Liability with Employment Exclusion deleted.
4. Contractual, including specified provision for the Contractor's obligation under Paragraph 3.18.
5. Owned, non-owned, and hired motor vehicles.
6. Broad Form Property Damage, including Completed Operations.
7. Umbrella Excess Liability."

11.1.1.2 The General Liability coverages shall be provided by a Commercial General Liability Policy on an occurrence basis.

11.1.1.3 The minimum limits of liability shall be as outlined in Section 11.1.2 below.

11.1.1.4 Owned and Non-Owned Aircraft or aerial drone devices. If an aircraft, whether owned or non-owned by the Contractor or any Subcontractor, is used in connection with the Work by the Contractor or any Subcontractor of any tier, the Contractor or Subcontractor, as applicable, shall advise the Owner or its representatives, shall provide a written explanation of the planned use of the aircraft, and shall provide Aircraft Liability Insurance at its sole cost and expense, the conditions and limits to be established by the Owner. The Owner reserves the right to prohibit the use of any aircraft in connection with the Work under this Contract. The minimum limit will be Five Million Dollars (\$5,000,000). This insurance shall be primary to all other insurance.

11.1.1.5 For the duration of these Contracts, the Contractor shall, at its own expense, purchase and maintain in a company or companies licensed and authorized to do business in the Commonwealth of Pennsylvania, Umbrella Liability Insurance, with limits as outlined herein:

.1 The umbrella liability insurance applies to all entities on site, including Contractors and Subcontractors.

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

11.1.2.1 Contractor shall provide, pay for and maintain (and shall require Subcontractors of all tiers to provide, pay for and maintain) insurance of the type and limits set forth below. Such insurance shall be maintained in full force and effect from the commencement of the Work by Contractor until final acceptance of the entire Project or the completion of all post-acceptance warranty or related Work by Contractor, whichever is later, and shall be for both on-site and off-site Work.

- .1 Employer's Liability (Worker's Compensation) Insurance:
 - .a Statutory - Amounts and coverage as required by laws of the Commonwealth of Pennsylvania.
 - .b The insurance shall cover all operations of Contractor (or the applicable Subcontractor). Such insurance shall be endorsed to include "Other States Coverage".
 - .c Employer's Liability:
 - \$1,000,000 each accident.
 - \$1,000,000 disease policy limit.
 - \$1,000,000 disease each employee.
- .2 Commercial General Liability insurance covering all Operations/ Work of Contractor (or the applicable Subcontractor). Such insurance shall be written on an Occurrence form. Coverage shall not be provided under a "Claims-Made" or "Modified Occurrence" policy without the prior, expressed written consent of Owner. Such insurance: (i) Shall be no less

comprehensive and no more restrictive than the coverage provided by the standard Insurance Services Office (ISO) form CG 00 01 (04/13); (ii) shall include by its terms or appropriate endorsements Bodily Injury, Property Damage, Personal Injury, Blanket Contractual, Independent Contractors, Products and Completed Operations coverages; (iii) shall include Products Liability coverage for any products manufactured, assembled, or otherwise worked upon away from the Project Site; and (iv) shall include coverage for "x" (explosion), "c" (collapse), and "u" (underground) exposures. Such insurance shall have the following minimum limits:

a. For the Contractor:

- 1) \$1,000,000 Bodily Injury Liability inc. Personal Injuries, Each Occurrence
- 2) \$1,000,000 Property Damage, Each Occurrence.
- 3) \$2,000,000 General Aggregate
- 4) \$1,000,000 Products/Completed Operations Aggregate
- 5) \$1,000,000 Personal and Advertising Injury

b. For all Subcontractors:

- 1) \$500,000 Bodily Injury Liability inc. Personal Injuries, Each Occurrence
- 2) \$500,000 Property Damage, Each Occurrence.
- 3) \$1,000,000 General Aggregate
- 4) \$500,000 Products/Completed Operations Aggregate
- 5) \$500,000 Personal and Advertising Injury

.c Products and completed operations insurance shall be maintained for a minimum period of three (3) years after Final Payment, and Contractor shall continue to provide evidence of such coverage to Owner on an annual basis during the aforementioned period.

.d Contractual Liability:

Bodily Injury - \$1,000,000 each occurrence.

Property Damage – Included each occurrence and aggregate.

.3 Automobile Liability Insurance including coverage for owned, non-owned, and hired vehicles with limits not less than stated below:

.a Bodily Injury Liability - \$1,000,000 each occurrence.

.b Property Damage Liability - \$1,000,000 each occurrence / \$1,000,000 aggregate.

.4 Umbrella Excess Liability providing additional limits for the Commercial General Liability, Automobile Liability, and Employer's Liability coverages:

.a Bodily Injury and Property Damage - \$3,000,000 in excess of required limits.

.5 Professional Liability insurance if Contractor (or applicable Subcontractors) will perform or retain others to perform professional services in connection with the Work, including engineering, architectural, medical, testing, environmental assessment or remediation, or design-build services, with a minimum limit of One Million Dollars (\$1,000,000) Per Wrongful Act, Error, or Omission.

.6 Owned and Non-Owned Aircraft. If an aircraft, whether owned or non-owned by the Contractor or any Subcontractor, is used in connection with the Work by the Contractor or any Subcontractor of any tier, the Contractor or Subcontractor, as applicable, shall advise the Owner or its representatives, shall provide a written explanation of the planned use of the aircraft, and shall provide Aircraft Liability Insurance at its sole cost and expense, the conditions and limits to be established by the Owner. The Owner reserves the right to prohibit the use of any aircraft in connection with the Work under this Contract. The minimum limit will be Five Million Dollars (\$5,000,000). This insurance shall be primary to all other insurance.

- .7 Asbestos and/or Lead Abatement. If Contractor (or applicable Subcontractors) will perform or retain others to perform abatement services; Asbestos and/or Lead Abatement Liability Insurance with limits of Ten Million Dollars (\$10,000,000) Each Occurrence and Ten Million Dollars (\$10,000,000) Aggregate when Work includes asbestos and/or lead abatement activities.

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

11.1.3.1 The cancellation notice on the Certificate of Insurance, ACORD Form 25S, shall be revised to read 'Should any of the above-described policies be canceled before the expiration date thereof, the issuing company will mail 30 days' written notice to the certificate holder named to the left.' In addition to ACORD Form 25S, AIA Document G715 shall also be completed, in full, and submitted.

11.1.3.2 The Contractor shall provide insurance coverage for portions of the work stored off the site after written approval of the Owner at the value established in the approval, and also for portions of the work in transit.

11.1.3.3 Certificates of Insurance shall be issued in duplicate.

11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations. If coverage is written on a "claims made" basis, Contractor warrants the purchase of an extended reporting period of not less than two (2) years.

11.1.5 The Contractor shall purchase insurance from a company having an A. M. Best & Co. rating of 'A' or better.

11.1.6 The Contractor shall provide an endorsement from his insurance carrier (in addition to Certificate required above) to the Owner within two weeks after execution of the Agreement stating that this subparagraph has been complied with. The endorsement shall obligate the insurance carrier to give the Owner thirty (30) days' notice of cancellations of the insurance coverage(s).

11.2 OWNER'S LIABILITY INSURANCE

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

11.3 PROPERTY INSURANCE

11.3.1 The Owner shall provide Builder's Risk Insurance at its option.

11.4 PERFORMANCE BOND AND PAYMENT BOND

11.4.1 The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder. Bonds shall be obtained from a company lawfully authorized to do business in the Commonwealth of Pennsylvania and have Best's ratings of 'A' or better; and the cost of the bonds shall be included in the Contract Sum. The amount of each bond shall be equal to 100 percent of the Contract Sum.

11.4.1.1 The Contractor shall deliver the required bonds to the Owner not later than three days following the date Agreement is entered into, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

11.4.1.2 The Contractor shall require the attorney who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the Power of Attorney.

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

12.1 Delete Subparagraph 12.2.2.1

12.2 Delete Subparagraph 12.2.2.3

12.3 Replace Subparagraph 12.2.5 with the following:

"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, the enforcement of Contractor's obligations under the Contract or claims by the Owner arising from or relating to latent defects or Work that does not conform to 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."

13.1 Replace Subparagraph 13.1 with the following:

"13.1 The Contract shall be governed by the laws of the Commonwealth of Pennsylvania and within the jurisdiction of either the Montgomery County Courts or Federal District Court for the Eastern District of Pennsylvania."

13.2 Delete Subparagraph 13.2.2

13.3 Add to Article 13 of General Conditions the following paragraphs 13.6 through 13.12:

"13.6 PENNSYLVANIA PREVAILING WAGE RATES

13.6.1 Attention is called to the fact that not less than the minimum salaries and wages set forth in the Pennsylvania Prevailing Wage Rates and identified in the Contract Documents must be paid on this project. This regulation and the general Pennsylvania prevailing minimum wage rates, (Act 442 of 1961, P.L. 987, amended), as determined by the Secretary of Labor and Industry, which shall be paid for each craft or classification of all workers needed to perform the contract during the anticipated term therefor in the locality in which public work is performed, are made part of this specification.

- a. State Prevailing Wage Rate schedules are included in the project's construction documents.
- b. It is the Bidder's responsibility to perform and to adhere to all related administrative functions, as required by the Commonwealth of Pennsylvania.
- c. Refer to Section 012160 for additional information and for the applicable prevailing wage rate determinations for the PENNSYLVANIA PREVAILING WAGE ACT

13.7 DISCRIMINATION PROHIBITED AND COMPLIANCE WITH ADA

13.7.1 According to 62 Pa. C.S.A. § 3701, the Contractor agrees that: at its own expense, shall conform to the nondiscrimination policies and plans required by the Contract Documents, the laws of the Commonwealth of Pennsylvania and all other laws applicable to the Project.

13.7.2 In the hiring of employees for the performance of work under the contract or any subcontract, no contractor, subcontractor, or any person acting on behalf of the contractor or subcontractor shall by reason of gender, race, creed or color discriminate against any citizen of this Commonwealth who is qualified and available to perform the work to which the employment relates.

13.7.3 No contractor or subcontractor or any person on their behalf shall in any manner discriminate against or intimidate any employee hired for the performance of work under the contract on account of gender, race, creed or color.

13.7.4 The contract may be canceled or terminated by the owner or government agency, and all money due or to become due under the contract may be forfeited for a violation of the terms or conditions of that portion of the contract.

13.7.5 Unless exempted by law, Contractor shall include the requirements of this section in every subcontract or purchase order so that it will be binding upon each subcontractor or supplier of the Contractor.

13.7.6 In the event the Contractor believes it necessary to modify its sequence of Work, the work environment or means and methods to comply with the applicable requirements of the Americans with Disabilities Act (ADA), Contractor shall notify the Architect and Owner in writing of the proposed modification. The Architect and Owner shall have a reasonable period of time to review the request before responding in writing to Contractor. All costs of the proposed modifications shall be borne by the Contractor, including impact costs to other Contractors or other parts of the Project, including any claims arising therefrom. The Contractor shall implement no modification until he receives written consent from the Architect.

13.7.7 If Contractor, its employees, subcontractors, suppliers or any other person or entity responsible to Contractor fails to comply with any applicable law or requirement of this Agreement or the Contract Documents, upon notice from the Architect or Owner, Contractor shall commence to cure such non-compliance within twenty-four (24) hours and shall achieve compliance within seventy-two (72) hours of receipt of written notice. Any failure of Contractor to do so after written notice to comply shall constitute a breach of contract and the Owner, in addition to its other rights in the event of a breach, shall have the right to terminate Contractor's right to perform the Work.

13.8 HUMAN RELATIONS ACT

13.8.1 The provisions of the Pennsylvania Human Relations Act, Act 222 of October 27, 1955 (P.L. 744) (43 P.S. Section 951, et. seq.) of the Commonwealth of Pennsylvania prohibit discrimination because of race, color, religious creed, ancestry, age, sex, national origin, handicap, or disability, by employers, employment agencies, labor organizations, contractors and others. The contractor shall agree to comply with the provisions of this Act as amended that is made part of this Agreement, by reference. Your attention is directed to the language of the Commonwealth's non-discrimination clause in 16 PA. Code 49.101.

13.9 PUBLIC WORKS EMPLOYMENT VERIFICATION ACT

13.9.1 Contractor shall comply with all applicable provisions of Pennsylvania's Public Works Employment Verification Act, 43 P.S. § 167.1, et seq. In accordance with the Act, the Contractor will use the E-Verify Program operated by the Department of Homeland Security to verify the employment eligibility of each new employee hired after January 1, 2013, within five (5) business days of the hire date. Prior to commencing work, the Contractor shall fully and accurately complete a Commonwealth of Pennsylvania Public Works Employment Verification Form and shall provide that form to the Owner. The Public Works Employment Verification Form can be obtained on the website of Pennsylvania's Department of General Services:

<https://www.dgs.pa.gov/Materials-Services-Procurement/Public-Works-Employment-Verification/Documents/UPDATED%20Public%20Works%20Employment%20Verification%20Form.pdf>

For all new employees hired during the course of the Project, the Subcontractor must continue to use the E-Verify Program to verify their employment eligibility. <https://www.e-verify.gov/>

1) Contractor's subcontractors, at any tier, are also required to comply with the provisions of the Public Works Employment Verification Act. If Subcontractor enters into any subcontracts relating to the Project, the subcontracts must contain information about the requirements of the Public Works Employment Verification Act, and must identify that the applicable form may be obtained at

<https://www.dgs.pa.gov/Materials-Services-Procurement/Public-Works-Employment-Verification/Documents/UPDATED%20Public%20Works%20Employment%20Verification%20Form.pdf>.

13.10 STANDARD OF QUALITY

13.10.1 The various materials and products specified in the specifications by name or description are given to establish a standard of quality and of cost for bid purposes. Except for a limited selection of products which are specifically identified in the contract documents. It is not the intent to limit the bidder, the bid or the evaluation of the bid to any one material or product specified, but rather to describe the minimum standard. When proprietary names are used and are followed by the words "no alternatives or substitutions shall be accepted," only the specific product identified can be provided. This limitation is restricted to a limited selection of products for this project. When proprietary names are used as a standard of quality, they shall be followed by the words "or alternatives of the quality necessary to meet the specifications." A bid containing an alternative which does not meet the specifications may be declared non-responsive. A bid containing an alternative may be accepted but, if an award is made to that bidder, the bidder will be required to replace any alternatives which do not meet the specifications.

13.11 USE OF STEEL AND STEEL PRODUCTS MADE IN THE UNITED STATES

13.11.1 In accordance with Act 3 of the 1978 General Assembly of the Commonwealth of Pennsylvania, if any steel or steel products are to be used or supplied in the performance of the contract, only those produced in the United States as defined therein shall be used or supplied in the performance of the contract or any subcontracts thereunder.

13.11.1.1 In accordance with Act 161 of 1982, cast iron products are also included and shall be produced in the United States. Act 144 of 1984 further defines "steel products" to include machinery and equipment. The act also provides clarification and penalties.

13.12 COMPETENT WORKMEN

13.12.1 No workmen shall be regarded as competent first class, within the meaning of this Act, except those who are duly skilled in their respective branches of labor, and who shall be paid not less than such rates of wages as set forth in the Pennsylvania Prevailing Wage Rate Determination Schedule made part of the Project Documents.

14.1 In Subparagraph 14.1.1, delete Clauses 14.1.1.3 and 14.1.1.4.

14.2 Append to Subparagraph 14.1.3 the following:

"Contractor shall not be entitled to any overhead or profit for any work not performed or any other losses or damages."

14.3 Change Subparagraph 14.2.1 as follows:

- In subparagraph 14.2.1.1 delete "repeatedly".
- In subparagraph 14.2.1.3 delete "repeatedly".
- In subparagraph 14.2.1.4 delete "substantial".
- Add the following subparagraphs:
 - .5** fails to abide by the Project Construction Schedule, and/or fails, within seven days after receipt of written notice to correct or recover the schedule, to provide required scheduling information; or
 - .6** institutes proceedings or consents to proceedings requesting relief under the Federal Bankruptcy Code or if a Petition under the Federal Bankruptcy Code is filed against the Contractor and such Petition is not dismissed within sixty (60) days from the date of said filing."

14.4 Add the following Subparagraph 14.2.4.1 to Subparagraph 14.2.4:

.1 The costs of finishing the Work include, without limitation, all reasonable attorney's fees and costs, additional title costs, insurance, additional fees paid to the Architect additional interest because of any delay in completing the Work, and all other direct and indirect costs incurred by the Owner by reason of the termination of the Contractor as stated herein."

14.5 Add the following Subparagraph 14.2.5:

"14.2.5 If the Owner terminates the contract for cause and it is subsequently determined that such termination was without sufficient cause or was improper for any reason whatsoever, such termination shall be deemed for all purposes to have been a termination for convenience and, in such event, Contractor shall be entitled to recover only those sums due pursuant to Section 14.4.3."

14.6 Replace Subparagraph 14.4.3 as follows:

"In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment only for Work executed and accepted, for any costs associated with demobilization and termination costs of material and equipment orders already placed for items which are unique to the Project. Contractor is not entitled to any overhead or profit for any work not performed or any other losses or damages."

15.1 Delete Subparagraph 15.1.2.

15.1 Replace Subparagraph 15.1.3 with the following:

"15.1.3 Notice of Claims. Claims by the Contractor must be initiated by written notice to the Owner and to the Architect. Claims by Contractor must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after Contractor first recognizes the condition giving rise to the Claim, whichever is later or within such shorter period prescribed by any other section of this Agreement or the Contract Documents; provided however, that the Contractor shall use its best efforts to furnish the Architect and the Owner, as expeditiously as possible, with notice of any Claim including, without limitation, those in connection with concealed or unknown conditions, once such Claim is recognized, and the Contractor shall cooperate with the Architect and the Owner in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim. An additional Claim made after the initial Claim has been implemented by Change Order will not be considered unless submitted in a timely manner."

15.2 Add the following Subparagraphs 15.1.3.1 through 15.1.3.7:

“15.1.3.1 Failure of the Contractor to timely initiate a claim, in writing, shall constitute waiver of such claim. A statement at a meeting, a change order request or correspondence that does not strictly comply with the notice of claim provisions shall not constitute sufficient or timely notice of a claim.

15.1.3.2 The written notice shall contain the following information and shall be verified under penalty of perjury by a person with authority to act on behalf of the Contractor that the facts and information contained in or relied upon in the notice is true and correct.

- .1** The date that the event giving rise to the claim commenced and the date upon which it was first recognized by the contractor.
- .2** The cause of the event giving rise to the claim.
- .3** The effect of the event giving rise to the claim on the construction progress including the identity of all elements of work that have been and will be impacted by the event and a specific explanation as to why and to what extent such work has been or will be impacted by the event giving rise to the claim.
- .4** If the event giving rise to the claim has impacted the schedule, a proposal for schedule recovery from the event that impacted the schedule that shall include a description of the means by which the Contractor intends to prevent further delay in the work.
- .5** A detailed itemization of each element of loss, damage or expense for which the Contractor seeks monies, along with data, documents or other information substantiating such Claim.

15.1.3.3 If the Contractor is claiming additional costs for delay, interference or inefficiency and the Contractor's notice of claim for delay, interference or inefficiency is timely submitted to the Architect pursuant to section 15.1.2, the Contractor shall submit a weekly Status Report until recovery from the delay, interference or inefficiency has been achieved. The Status Report shall be in writing and accompanied by an Affidavit subject to the penalty of perjury. The Status Report shall:

- .1** Explain the efforts taken to recover from the delay, interference or inefficiency.
- .2** Identify the cause of any continuation of the delay, interference or inefficiency or any hindrance to the Contractor's proposed recovery plan.
- .3** Include a breakdown of the costs resulting from the delay, interference or inefficiency for any and all costs for which it is making a claim, attaching cost reports, certified payroll and invoices that support the costs.
- .4** The final Status Report shall identify the date that recovery from the delay, interference or inefficiency was achieved.

15.1.3.4 As a part of the Contractor's initial notification and status updates thereafter, the Contractor shall include in the information submitted with its claim, and any supplemental information provided, a detailed description of the specific reason that caused the additional damages requested and shall also fully identify any other causes, including inefficiencies caused by, other contractors, its own forces, or those of its subcontractors. The Contractor shall provide scheduling information that shows the critical impact to the schedule at the time it first provides notice and the impact anticipated at that time for future work. As a part of its status update of information required to support its request, the Contractor will provide a regular update of the schedule analysis showing continued critical impact on a monthly basis, showing both the impact that occurred as of that update and the continued anticipated impact for future work from the date of the update. The Contractor acknowledges that the impact of the inefficiency of each change order shall be identified at the time of a change order request, and that the Contractor shall make no claim for any inefficiency based on a cumulative impact of the change orders.

15.1.3.5 Even though formulas or means of calculating damages other than the records described in this contract are expressly prohibited and are contrary to the terms of this Agreement, the Owner

understands that courts may still permit the Contractor to present damages for inefficiencies. Contractor agrees to the following with regard to any claim for inefficiency:

- .1** Claims for inefficiencies must be made within the time requirements of this Article 15.1.2 herein or other applicable provision of this contract. To the extent the full amount of inefficiency cannot be determined, the Contractor must provide proper notice of its first occurrence of inefficiency costs even if the full amount of the claim cannot be determined. The Contractor must provide monthly updates of the amounts of inefficiency it has incurred in the prior month, with full documentation and invoices for labor, supervision and other inefficiency costs.
- .2** To the extent the Contractor uses a "measured mile" approach, or any similar formula to calculate the damages such as earned value or similar analysis, the Contractor will identify the unimpacted activity period at the time it first makes its claim. The Contractor acknowledges that the use of such methods for calculating inefficiency require the identification of a period unimpacted by inefficiency and that such unimpacted period must occur prior to the period of inefficiency for such a method to be valid.
- .3** The Contractor shall not pursue any change order or claim relying on the Eichley formula, Manshul formula or other similar formula in pursuing any overhead amounts, since these formulas do not calculate overhead amounts with any degree of reasonable certainty. The Contractor agrees that any amounts for overhead, including home office overhead, are included in the Contractor's mark-up for overhead and profit as described in this agreement.

15.1.3.6 Payment of a change order shall constitute accord and satisfaction of all claims in connection with the change or changes to the Contract addressed by the change order, and it is understood and agreed that a signed change order form shall be the complete and fully integrated agreement for all related costs and that there are no oral or written understandings, representations, or agreements, directly or indirectly, connected with the Change Order that are not affirmatively stated on the signed Change Order form. The Contractor's execution of a change order constitutes a representation that it will make no further claims for damages inconsistent with this paragraph.

15.1.3.7 Strict compliance with the provisions of 15.1.2 and all of its subparts is a condition precedent to the presentation of any claim for delay, interference or inefficiency."

15.4 Replace Subparagraph 15.1.6.1 with the following:

"**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. In the case of a continuing delay only one Claim is necessary. Refer to Article 8, Paragraph 8.3."

15.5 Append the following to Subparagraph 15.1.6.2:

"Contractor must also provide documentation regarding the weather that the Contractor anticipated and the information upon which the Contractor based his anticipation of weather conditions. Winter or other inclement weather is not condition for any project delay or claim. Contractor is to follow all measures to maintain the protection of the work, temperature controls, remove snow, ice and other accumulations to ensure that the work continues."

15.7 Change Subparagraph 15.1.7.2 as follows:

Following "stationed there," insert "for loss of bonding capacity,"

15.8 Append to Subparagraph 15.1.7 the following:

"It is understood and agreed that Contractor's waiver of consequential damages against the Owner shall extend to the benefit of the Architect, its owners, directors and employees, and the Architect's consultants.

.3 The Contractor represents that its agreement to pursue costs, damages or claims in strict accordance with Article 15 herein or any other provision of the Contract is material to the award of the contract to the Contractor and that the Owner and Architect are entitled to rely upon this representation. The Contractor further agrees that this paragraph shall survive termination or rescission of this agreement even in the event of a material breach of contract by the Owner."

15.8 Replace Subparagraph 15.2.1 as follows:

"**15.2.1** Claims of the Contractor, 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 and 10.4 shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker. An initial decision shall be required as a condition precedent to any right of the Contractor to pursue any Claim in arbitration or litigation (as elected by the Owner) arising. 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."

15.9 Replace Subparagraph 15.2.5 as follows:

"**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 therefore; and (3) shall be issued to the Contractor and the Owner. The initial decision shall be final and binding upon the Contractor, unless, within fifteen (15) days of that decision, the Contractor provides written notice to the Owner, with copies to the Architect, that the Contractor seeks to submit the Claim to arbitration or litigation as elected by the Owner as provided in Section 15.3. Failure of the Contractor to provide such written notice within this time limit shall constitute a waiver of such Claim. The decision of the Initial Decision Maker upon a Claim shall not be binding upon the Owner."

15.10 Delete Subparagraphs 15.2.6 through 15.2.8 in their entirety.

15.11 Delete Paragraph 15.3 and Subparagraphs 15.3.1 through 15.3.4 in their entirety.

15.12 Delete Article 15.4 and Subparagraphs 15.4.1 thru 15.4.4.3 in their entirety.

16.1 Add to General Conditions the following Article 16:

"ARTICLE 16 MECHANICS' LIENS

16.1 Contractor shall promptly pay for all materials furnished, labor supplied or performed by others, rental for equipment employed, and services rendered by public utilities in or in connection with the prosecution of the work, whether or not the said material, labor, equipment, and services entered into and become component parts of the work or improvement contemplated. This provision is intended to ensure payment of every person, co-partnership, association or corporation who, as subcontractor or otherwise has furnished material, supplied or performed labor, rented equipment or supplied services in connection with the prosecution of the work as aforesaid, and shall preclude the filing by any such person, co-partnership, association or corporation, of any mechanic's lien claim against Owner for such material, labor, or rental of equipment.

16.2 The Contractor, for any and all subcontractors and parties acting through, or under them or any of the, covenants and agrees by and with the Owner that no mechanic's liens or claims shall be filed

or maintained by the said Contractor or any subcontractors or other party acting through or under it, them or any of them against the aforesaid building and/or the lot of ground or curtilage appurtenant thereto, or against the interests of the Owner on account of any work done or materials furnished by them or any of them whether prior to the execution of this Contract, under the aforesaid contract or under any supplemental contract thereto for extra or additional work or otherwise for, toward, in or about the work on the lot of ground hereinabove described, or any work or material therefor, and the said Contractor for itself and its subcontractors and all persons acting for or under it, them or any of them hereby expressly waives and relinquishes the right to have, file, or maintain any mechanic's claim or liens against the said building and/or the lot of ground hereinabove described or curtilage appurtenant thereto; to the interest of the Owner, it being the intent of the parties hereto that Contractor shall only possess those rights and remedies against Owner which are created by the terms and provisions of this Agreement and are based upon the contractual relationship between Owner and Contractor as defined and limited by this Agreement and any changes or modifications thereto. Upon securing the Payment Bond and providing satisfactory proof thereof to Owner, Contractor and Owner will enter into the appropriate Stipulation Against Liens, in accordance with Pennsylvania's Mechanic's Lien Law, and cause the same to be filed with the Centre County Prothonotary as notice of lien waivers to all parties working for the Contractor under this Contract.

16.3 Contractor further agrees that if, notwithstanding the foregoing, any suit, lien or claim occasioned by the Contractor's performance of this Contract, whether directly or indirectly, is filed by the Contractor, its Subcontractor, sub-subcontractors, material, men, or suppliers in any court having jurisdiction of the premises and the same matures into a lien against the property, Contractor shall immediately cause such lien to be discharged as to such property by posting bond or by such other means as may be provided under the applicable statutes and rules of court or shall otherwise indemnify, defend and save Owner harmless on account of any such claims, liens, or suits."

END OF SECTION 007300



COMMONWEALTH OF PENNSYLVANIA

PUBLIC WORKS EMPLOYMENT VERIFICATION FORM

Date _____

Business or Organization Name (Employer) _____

Address _____

City _____ State _____ Zip Code _____

☐ Contractor ☐ {dzõÖ2yúñl-Öú2W óÖKŠÖŧ 2yŠú

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

SECTION 007340 - PREVAILING WAGE RATES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. The provisions of the Pennsylvania Prevailing Wage Act approved August 15, 1961 (Act No. 442), as amended August 9, 1963 (Act No. 342), and the Regulations issued pursuant thereto are hereby incorporated in and made a part of the General Requirements of the Project. The Secretary of Department of Labor and Industry has predetermined the minimum wage rates, including contributions for employee benefits, which shall be paid to the workmen employed in the performance of the Contract.
- B. The following provisions shall also apply to this contract:
 - 1. Provisions to Apply: The contract provisions shall apply to all work performed on the Contract by the Contractor, and to all work performed on the contract by all Subcontractors.
 - 2. Subcontracts: The Contractor shall insert in each of his subcontracts all of the stipulations contained in these required provisions and such other stipulations as may be required.
 - 3. Worker Classifications: No workers may be employed on the Work except in accordance with the classifications set forth in the decision of the Secretary. In the event that additional or different classifications are necessary, the procedure set forth in Section 7 of these Regulations shall be followed.
 - 4. Workers to be Paid Unconditionally: All workers employed or working on the Work shall be paid unconditionally, regardless of whether any contractual relationship exists or the nature of any contractual relationship which may be alleged to exist between any Contractor, Subcontractor and worker, not less than 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 the Regulations shall prohibit the payment of more than the general prevailing minimum wage rates as determined by the Secretary to any worker on public work.
 - 5. Post Wage Determination: 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 any changes thereof, in a prominent and easily accessible place or places at the site of the work and at such place or places used by them to pay workers their wages. The posted notice of wage rates must contain the following information:
 - a. Name of Project.
 - b. Name of public body for which it is being constructed.
 - c. The crafts and classifications of workers listed in the Secretary's general prevailing minimum wage rate determination for the particular project.
 - d. The general prevailing minimum wage rates determined for each craft and classification and the effective date of any changes.

- e. A statement advising workers that if they have been paid less than the general prevailing minimum wage rate for their job classification or that the Contractor and/or Subcontractor are not complying with the Act or these Regulations in any manner whatsoever, they may file a protest in writing with the Secretary of Labor and Industry within three (3) months of the date of the occurrence, objecting to the payment to any Contractor to the extent of the amount or amounts due or to become due to them as wages for work performed on the public work project. Any worker 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 must be exercised within six (6) months from the occurrence of the event creating such right.
- 6. Records: The Contractor and all Subcontractors shall keep an accurate record showing the name, craft and/or classification, number of hours worked per day, and the actual hourly rate of wage paid (including employee benefits) to each worker employed by him in connection with the Work and such record must include any deductions from each worker. The record shall be preserved for two years from the date of payment and shall be open at all reasonable hours to the inspection of the public body awarding the contract and to the Secretary or his duly authorized representatives.
- 7. Apprentices: Apprentices shall be limited to such numbers as shall be 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 provisions of the Apprenticeship and Training Act approved July 14, 1961 (Act No. 304) and the Rules and Regulations issued pursuant thereto shall be employed on the Work project. Any worker using the tools of a craft who does not qualify as an apprentice within the provisions of this subsection shall be paid the rate predetermined for journeymen in that particular craft and/or classification.
- 8. Deductions: Wages shall be paid without any 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 workers.
- D. Violation: Payment of compensation to workers for work performed on the 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 these Regulations, regardless of the average hourly earnings resulting therefrom.
- E. Filing Requirements: The 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 all workers have been paid wages in strict conformity with the provisions of the contract as prescribed by this Section 3 of these Regulations, or if any wages remain unpaid to set forth the amount of wages due and owing to each worker respectively.

1.2 WAGE RATES

- A. The Pennsylvania Prevailing Minimum Wage Rates Schedule, Serial #24-07964 dated August 29, 2024, 9 pages, is attached to Section 007346.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 007340

DOCUMENT 007346 - WAGE DETERMINATION SCHEDULE

PART 1 - GENERAL

1.1 DOCUMENTS

- A. The Prevailing Minimum Wage Predetermination, included herein below, as determined by the Secretary of Labor and Industry of the Commonwealth of Pennsylvania, is a part of the Contract documents for this Project.
 - 1. Serial Number: 24-07964
 - 2. Determination Date: 8/29/2024
- B. Submit a Certified Payroll Certificate each week to the Architect.
- C. The prevailing wage rates and fringe benefits determined in accordance with the provisions of Federal statutes constitute the minimum wages payable on Federal and Federally-assisted construction projects by contractors and subcontractors to laborers and mechanics of the specified classes engaged on contract work of the character and in the localities described therein.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ELECTRONIC DOCUMENTS

- A. Please go to www.dli.pa.gov to search and view Prevailing Wage Project Rates or view the Project Rates attached.

DOCUMENT CONTINUES ON NEXT PAGE

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project Name:	Lower Pottsgrove Township Municipal Building & Police Station
General Description:	Renovations and addition to existing two-story structure.
Project Locality	Pottstown, PA
Awarding Agency:	Lower Pottsgrove Township
Contract Award Date:	10/4/2024
Serial Number:	24-07964
Project Classification:	Building
Determination Date:	8/29/2024
Assigned Field Office:	Philadelphia
Field Office Phone Number:	(215)560-1858
Toll Free Phone Number:	
Project County:	Montgomery County

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 24-07964 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	6/1/2023		\$57.84	\$43.36	\$101.20
Asbestos & Insulation Workers	5/1/2024		\$59.37	\$46.03	\$105.40
Boilermaker (Commercial, Institutional, and Minor Repair Work)	3/1/2024		\$36.71	\$19.13	\$55.84
Boilermakers	1/1/2023		\$51.27	\$35.30	\$86.57
Boilermakers	1/1/2024		\$52.10	\$35.72	\$87.82
Bricklayer	5/1/2023		\$47.50	\$31.42	\$78.92
Carpenter - Chief of Party (Surveying & Layout)	5/1/2023		\$50.57	\$29.02	\$79.59
Carpenter - Chief of Party (Surveying & Layout)	5/1/2024		\$52.58	\$29.02	\$81.60
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2023		\$43.97	\$29.02	\$72.99
Carpenter - Instrument Person (Surveying & Layout)	5/1/2024		\$45.72	\$29.02	\$74.74
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2023		\$21.99	\$20.62	\$42.61
Carpenter - Rodman (Surveying & Layout)	5/1/2024		\$22.86	\$20.62	\$43.48
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2023		\$43.97	\$29.02	\$72.99
Carpenters	5/1/2024		\$45.72	\$29.02	\$74.74
Carpenters	5/1/2025		\$47.47	\$29.02	\$76.49
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2023		\$44.20	\$32.96	\$77.16
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
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		\$38.77	\$31.12	\$69.89
Drywall Finisher	5/1/2024		\$42.25	\$32.56	\$74.81
Electricians	5/2/2022		\$53.94	\$42.97	\$96.91
Electricians	5/1/2023		\$55.41	\$44.50	\$99.91
Electricians	4/29/2024		\$56.67	\$46.24	\$102.91
Elevator Constructor	1/1/2023		\$66.21	\$43.64	\$109.85
Elevator Constructor	1/1/2024		\$68.97	\$44.70	\$113.67
Floor Coverer	5/1/2023		\$50.12	\$29.21	\$79.33
Floor Coverer	5/1/2024		\$52.19	\$29.21	\$81.40
Glazier	5/1/2023		\$46.68	\$36.62	\$83.30
Glazier	5/1/2024		\$48.00	\$37.50	\$85.50

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 24-07964 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Interior Finish	5/1/2019		\$30.20	\$25.80	\$56.00
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40
Iron Workers (Bridge, Structural, Ornamental, Precast)	1/1/2023		\$50.70	\$39.51	\$90.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Riggers)	7/1/2024		\$44.64	\$34.39	\$79.03
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Laborers (Class 01 - See notes)	5/1/2022		\$33.35	\$25.65	\$59.00
Laborers (Class 01 - See notes)	5/1/2023		\$34.60	\$25.80	\$60.40
Laborers (Class 01 - See notes)	5/1/2024		\$35.85	\$26.00	\$61.85
Laborers (Class 02 - See notes)	5/1/2022		\$36.70	\$27.00	\$63.70
Laborers (Class 02 - See notes)	5/1/2023		\$37.95	\$27.30	\$65.25
Laborers (Class 02 - See notes)	5/1/2024		\$39.40	\$27.55	\$66.95
Laborers (Class 03 - See notes)	5/1/2022		\$33.77	\$25.83	\$59.60
Laborers (Class 03 - See notes)	5/1/2023		\$35.02	\$25.98	\$61.00
Laborers (Class 03 - See notes)	5/1/2024		\$36.27	\$26.18	\$62.45
Laborers (Class 04 - See notes)	5/1/2022		\$33.77	\$25.83	\$59.60
Laborers (Class 04 - See notes)	5/1/2023		\$35.02	\$25.98	\$61.00
Laborers (Class 04 - See notes)	5/1/2024		\$36.27	\$26.18	\$62.45
Laborers (Class 05 - See notes)	5/1/2022		\$33.35	\$25.65	\$59.00
Laborers (Class 05 - See notes)	5/1/2023		\$34.60	\$25.50	\$60.10
Laborers (Class 05 - See notes)	5/1/2024		\$35.85	\$26.00	\$61.85
Landscape Laborer	5/1/2023		\$29.45	\$23.98	\$53.43
Landscape Laborer	5/1/2024		\$30.70	\$24.23	\$54.93
Marble Finisher	5/1/2023		\$39.52	\$29.30	\$68.82
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Mason Tender, Cement	5/1/2019		\$30.52	\$25.98	\$56.50
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2023		\$51.60	\$35.81	\$87.41
Millwright	5/1/2024		\$54.67	\$35.81	\$90.48
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators (Building, Class 01 - See Notes)	5/1/2023		\$52.20	\$32.81	\$85.01
Operators (Building, Class 01 - See Notes)	5/1/2024		\$53.36	\$33.65	\$87.01
Operators (Building, Class 01 - See Notes)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators (Building, Class 01A - See Notes)	5/1/2023		\$55.20	\$33.70	\$88.90
Operators (Building, Class 01A - See Notes)	5/1/2024		\$56.37	\$34.53	\$90.90
Operators (Building, Class 01A - See Notes)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators (Building, Class 02 - See Notes)	5/1/2023		\$51.95	\$32.74	\$84.69
Operators (Building, Class 02 - See Notes)	5/1/2024		\$53.11	\$33.58	\$86.69
Operators (Building, Class 02 - See Notes)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		\$55.43	\$35.26	\$90.69

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 24-07964 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Building, Class 02A - See Notes)	5/1/2023		\$54.97	\$33.61	\$88.58
Operators (Building, Class 02A - See Notes)	5/1/2024		\$56.13	\$34.45	\$90.58
Operators (Building, Class 02A - See Notes)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators (Building, Class 03 - See Notes)	5/1/2023		\$47.87	\$31.53	\$79.40
Operators (Building, Class 03 - See Notes)	5/1/2024		\$49.03	\$32.37	\$81.40
Operators (Building, Class 03 - See Notes)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators (Building, Class 04 - See Notes)	5/1/2023		\$47.57	\$31.44	\$79.01
Operators (Building, Class 04 - See Notes)	5/1/2024		\$48.73	\$32.28	\$81.01
Operators (Building, Class 04 - See Notes)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators (Building, Class 05 - See Notes)	5/1/2023		\$45.85	\$30.93	\$76.78
Operators (Building, Class 05 - See Notes)	5/1/2024		\$47.00	\$31.78	\$78.78
Operators (Building, Class 05 - See Notes)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators (Building, Class 06 - See Notes)	5/1/2023		\$44.85	\$30.65	\$75.50
Operators (Building, Class 06 - See Notes)	5/1/2024		\$46.02	\$31.48	\$77.50
Operators (Building, Class 06 - See Notes)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators (Building, Class 07A- See Notes)	5/1/2023		\$63.33	\$37.68	\$101.01
Operators (Building, Class 07A- See Notes)	5/1/2024		\$64.80	\$38.61	\$103.41
Operators (Building, Class 07A- See Notes)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators (Building, Class 07B- See Notes)	5/1/2023		\$63.04	\$37.59	\$100.63
Operators (Building, Class 07B- See Notes)	5/1/2024		\$64.50	\$38.53	\$103.03
Operators (Building, Class 07B- See Notes)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters Class 1 (see notes)	5/1/2023		\$42.32	\$32.91	\$75.23
Painters Class 1 (see notes)	5/1/2024		\$42.97	\$34.11	\$77.08
Painters Class 4 (see notes)	5/1/2023		\$44.41	\$32.91	\$77.32
Painters Class 4 (see notes)	5/1/2024		\$45.06	\$34.11	\$79.17
Plasterers	5/1/2021		\$38.37	\$31.84	\$70.21
Plasterers	5/1/2023		\$39.32	\$32.64	\$71.96
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2023		\$64.73	\$37.61	\$102.34
plumber	5/1/2024		\$67.53	\$38.31	\$105.84
Pointers, Caulkers, Cleaners	5/1/2023		\$48.80	\$30.70	\$79.50
Roofers (Composition)	5/1/2023		\$42.63	\$34.62	\$77.25
Roofers (Composition)	5/1/2024		\$44.13	\$34.77	\$78.90
Roofers (Shingle)	5/1/2021		\$30.50	\$21.55	\$52.05
Roofers (Shingle)	5/1/2023		\$32.85	\$22.10	\$54.95
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2021		\$33.50	\$21.55	\$55.05

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 24-07964 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Roofers (Slate & Tile)	5/1/2023		\$35.85	\$22.10	\$57.95
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55
Sheet Metal Workers	5/1/2023		\$57.31	\$48.97	\$106.28
Sheet Metal Workers	5/1/2024		\$59.22	\$50.56	\$109.78
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
Sign Makers and Hangars	7/15/2024		\$32.32	\$25.82	\$58.14
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Steamfitters	5/1/2023		\$67.37	\$41.99	\$109.36
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Stone Masons	5/1/2023		\$47.20	\$31.95	\$79.15
Terrazzo Finisher	5/1/2023		\$43.75	\$27.86	\$71.61
Terrazzo Grinder	5/1/2023		\$44.02	\$27.86	\$71.88
Terrazzo Mechanics	5/1/2023		\$50.26	\$29.56	\$79.82
Tile Finisher	5/1/2023		\$39.52	\$29.30	\$68.82
Tile Setter	5/1/2023		\$50.26	\$29.56	\$79.82
Truckdriver class 1(see notes)	5/1/2022		\$35.60	\$20.74	\$56.34
Truckdriver class 1(see notes)	5/1/2023		\$36.29	\$21.55	\$57.84
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 2 (see notes)	5/1/2022		\$35.70	\$20.74	\$56.44
Truckdriver class 2 (see notes)	5/1/2023		\$36.39	\$21.55	\$57.94
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Window Film / Tint Installer	6/1/2019		\$24.52	\$12.08	\$36.60
Window Film / Tint Installer	6/1/2024		\$26.37	\$14.83	\$41.20

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 24-07964 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Carpenter - Chief of Party (Surveying & Layout)	5/1/2023		\$63.24	\$29.06	\$92.30
Carpenter - Chief of Party (Surveying & Layout)	5/1/2024		\$65.19	\$29.06	\$94.25
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$67.15	\$29.06	\$96.21
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$69.10	\$29.06	\$98.16
Carpenter - Instrument Person (Surveying & Layout)	5/1/2023		\$54.99	\$29.06	\$84.05
Carpenter - Instrument Person (Surveying & Layout)	5/1/2024		\$56.69	\$29.06	\$85.75
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$58.39	\$29.06	\$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		\$60.09	\$29.06	\$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2023		\$43.99	\$22.41	\$66.40
Carpenter - Rodman (Surveying & Layout)	5/1/2024		\$45.35	\$22.41	\$67.76
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$46.71	\$22.41	\$69.12
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$48.07	\$22.41	\$70.48
Carpenter	5/1/2023		\$54.99	\$29.06	\$84.05
Carpenter	5/1/2024		\$56.69	\$29.06	\$85.75
Carpenter	5/1/2025		\$58.49	\$29.06	\$87.55
Carpenter	5/1/2026		\$60.19	\$29.06	\$89.25
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
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		\$63.10	\$37.99	\$101.09
Dockbuilder/ Pile driver diver	5/1/2024		\$66.25	\$37.99	\$104.24
Dockbuilder/ Pile driver diver	5/1/2025		\$69.04	\$37.99	\$107.03
Dockbuilder/ Pile driver diver	5/1/2026		\$71.23	\$37.99	\$109.22
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		\$59.17	\$31.48	\$90.65
Electric Lineman	5/29/2023		\$60.48	\$32.77	\$93.25
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Iron Workers (Bridge, Structural, Ornamental, Precast)	1/1/2023		\$50.70	\$39.51	\$90.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Laborers (Class 01 - See notes)	5/1/2022		\$36.30	\$27.20	\$63.50
Laborers (Class 01 - See notes)	5/1/2023		\$37.55	\$27.45	\$65.00
Laborers (Class 01 - See notes)	5/1/2024		\$38.80	\$27.65	\$66.45
Laborers (Class 02 - See notes)	5/1/2022		\$36.50	\$27.20	\$63.70
Laborers (Class 02 - See notes)	5/1/2023		\$37.75	\$27.45	\$65.20

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 24-07964 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 02 - See notes)	5/1/2024		\$39.00	\$27.65	\$66.65
Laborers (Class 03 - See notes)	5/1/2022		\$36.50	\$27.20	\$63.70
Laborers (Class 03 - See notes)	5/1/2023		\$37.75	\$27.45	\$65.20
Laborers (Class 03 - See notes)	5/1/2024		\$39.00	\$27.65	\$66.65
Laborers (Class 04 - See notes)	5/1/2022		\$31.10	\$27.20	\$58.30
Laborers (Class 04 - See notes)	5/1/2023		\$32.35	\$27.45	\$59.80
Laborers (Class 04 - See notes)	5/1/2024		\$33.60	\$27.65	\$61.25
Laborers (Class 05 - See notes)	5/1/2022		\$37.15	\$27.20	\$64.35
Laborers (Class 05 - See notes)	5/1/2023		\$38.40	\$27.45	\$65.85
Laborers (Class 05 - See notes)	5/1/2024		\$39.65	\$27.65	\$67.30
Laborers (Class 06 - See notes)	5/1/2022		\$37.20	\$27.20	\$64.40
Laborers (Class 06 - See notes)	5/1/2023		\$38.40	\$27.45	\$65.85
Laborers (Class 06 - See notes)	5/1/2024		\$39.70	\$27.65	\$67.35
Laborers (Class 07 - See notes)	5/1/2022		\$37.05	\$27.20	\$64.25
Laborers (Class 07 - See notes)	5/1/2023		\$38.30	\$27.45	\$65.75
Laborers (Class 07 - See notes)	5/1/2024		\$39.55	\$27.65	\$67.20
Laborers (Class 08 - See notes)	5/1/2022		\$36.80	\$27.20	\$64.00
Laborers (Class 08 - See notes)	5/1/2023		\$38.05	\$27.45	\$65.50
Laborers (Class 08 - See notes)	5/1/2024		\$39.30	\$27.65	\$66.95
Laborers (Class 09 - See notes)	5/1/2022		\$36.65	\$27.20	\$63.85
Laborers (Class 09 - See notes)	5/1/2023		\$37.90	\$27.45	\$65.35
Laborers (Class 09 - See notes)	5/1/2024		\$39.15	\$27.65	\$66.80
Laborers (Class 10- See notes)	5/1/2022		\$36.80	\$27.20	\$64.00
Laborers (Class 10- See notes)	5/1/2023		\$38.05	\$27.45	\$65.50
Laborers (Class 10- See notes)	5/1/2024		\$39.30	\$27.65	\$66.95
Laborers (Class 11 -See Notes)	5/1/2022		\$36.70	\$27.20	\$63.90
Laborers (Class 11 -See Notes)	5/1/2023		\$37.95	\$27.45	\$65.40
Laborers (Class 11 -See Notes)	5/1/2024		\$39.20	\$27.65	\$66.85
Laborers (Class 12 -See Notes)	5/1/2022		\$38.40	\$27.20	\$65.60
Laborers (Class 12 -See Notes)	5/1/2023		\$39.65	\$27.45	\$67.10
Laborers (Class 12 -See Notes)	5/1/2024		\$40.90	\$27.65	\$68.55
Laborers (Class 13 -See Notes)	5/1/2022		\$40.43	\$27.20	\$67.63
Laborers (Class 13 -See Notes)	5/1/2023		\$41.65	\$27.45	\$69.10
Laborers (Class 13 -See Notes)	5/1/2024		\$42.93	\$27.65	\$70.58
Laborers (Class 14 -See Notes)	5/1/2022		\$36.55	\$27.20	\$63.75
Laborers (Class 14 -See Notes)	5/1/2023		\$38.25	\$27.45	\$65.70
Laborers (Class 14 -See Notes)	5/1/2024		\$39.50	\$27.65	\$67.15
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2022		\$30.17	\$19.18	\$49.35
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2023		\$31.42	\$19.43	\$50.85
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2024		\$32.67	\$19.63	\$52.30
Laborers Utility (PGW ONLY)	5/1/2022		\$37.20	\$19.18	\$56.38
Laborers Utility (PGW ONLY)	5/1/2023		\$38.45	\$19.43	\$57.88
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Landscape Laborer	5/1/2022		\$27.73	\$23.65	\$51.38

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 24-07964 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Landscape Laborer	5/1/2023		\$29.03	\$23.80	\$52.83
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Millwright	5/1/2023		\$51.60	\$35.81	\$87.41
Millwright	5/1/2024		\$54.67	\$35.81	\$90.48
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2023		\$52.20	\$32.81	\$85.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2024		\$53.36	\$33.65	\$87.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2023		\$55.20	\$33.70	\$88.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2024		\$56.37	\$34.53	\$90.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2023		\$51.95	\$32.74	\$84.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2024		\$53.11	\$33.58	\$86.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2023		\$54.97	\$33.61	\$88.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2024		\$56.13	\$34.45	\$90.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2023		\$47.87	\$31.53	\$79.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2024		\$49.03	\$32.37	\$81.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2023		\$47.57	\$31.44	\$79.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2024		\$48.73	\$32.28	\$81.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		\$49.88	\$33.13	\$83.01

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 24-07964 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2023		\$45.85	\$30.93	\$76.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2024		\$47.00	\$31.78	\$78.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2023		\$44.85	\$30.65	\$75.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2024		\$46.02	\$31.48	\$77.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2023		\$63.33	\$37.68	\$101.01
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2024		\$64.80	\$38.61	\$103.41
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2023		\$63.04	\$37.59	\$100.63
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2024		\$64.50	\$38.53	\$103.03
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2023		\$42.10	\$27.43	\$69.53
Painters Class 2 (see notes)	2/1/2023		\$48.82	\$32.09	\$80.91
Painters Class 2 (see notes)	2/1/2024		\$49.57	\$33.34	\$82.91
Painters Class 3 (see notes)	2/1/2023		\$59.78	\$32.13	\$91.91
Painters Class 3 (see notes)	2/1/2024		\$60.53	\$33.38	\$93.91
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2022		\$61.34	\$40.28	\$101.62
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2023		\$64.00	\$41.68	\$105.68
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2024		\$66.80	\$42.93	\$109.73
Truckdriver class 1(see notes)	5/1/2022		\$35.45	\$20.74	\$56.19
Truckdriver class 1(see notes)	5/1/2023		\$36.14	\$21.55	\$57.69
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 2 (see notes)	5/1/2022		\$35.55	\$20.74	\$56.29
Truckdriver class 2 (see notes)	5/1/2023		\$36.24	\$21.55	\$57.79
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28

SECTION 007400 – QUALIFIED CONTRACTORS

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. Each Prime Contractor and Major Subcontractor shall be a qualified, responsible contractor that has sufficient capabilities in all respects to successfully perform the Work for which they are engaged. Prime Contractors and major subcontractors bidding or otherwise participating in the Work shall also be required to have a satisfactory past performance record and a satisfactory record of law compliance, integrity, and business ethics.
- B. Related Requirements
 - 1. Section 011200 “Multiple Contract Summary” for list of Prime Contracts and associated scopes of work and responsibilities.

1.3 DEFINITIONS

- A. Bidder: A person that submits a bid in response to an invitation for bid.
- B. Contract: A type of written agreement, regardless of what it may be called, for the procurement or disposal of supplies, services or construction and executed by all parties.
- C. Contractor: The term “Prime Contractor” or “Contractor” as used in the Bidding and Contract Documents refer to the Contractor to whom an award is made to perform the Work and has entered into a direct contract agreement for construction activities with the Owner.
- D. Major Subcontractor: The term “Major Subcontractor” shall be any subcontract that exceeds 5% of the total prime contract value.
- E. Default: Failure of a Contractor to perform their contractual obligations within the terms of the Contract.
- F. Responsible Contractor: A contractor that has submitted a responsive bid and that possess the capability to fully perform the contract requirements in all respects and the integrity and reliability to assure a good faith performance, including the necessary experience, equipment, technical skills, and qualifications and organizational, financial and personnel resources
- G. Responsive Bid: A bid which conforms in all material respects to the requirements and criteria in the invitation to bid.

1.4 QUALIFIED CONTRACTOR CERTIFICATION

- A. Each Prime Contractor shall submit a Qualified Contractor Certification form, as specified herein. In addition, each prime contractor shall identify their Major Subcontractors who are likewise required to provide a Qualified Contractor Certification form.
1. The Qualified Contractor Certification Form shall be completed on the form provided.
 2. In the Qualified Contractor Certification Form, the Prime Contractor shall confirm the following facts regarding past performance and work history and the Prime Contractors current qualifications and performance capabilities.
 - a. The Prime Contractor and its employees have valid, effective drivers' licenses, registrations, certificates, or other credentials required by Federal, State, County, or Local law, or as required by the specifications, including, but not limited to, licenses, registrations or certificates required to: (a) do business in the designated locale; and (b) perform the Work it is to be performed. These shall include, but not limited to, licenses, registrations, or certificates for any type of Work which the Prime Contractor proposes to self-perform.
 - b. The Prime Contractor has not been debarred or suspended by any Federal, State, or Local government agency or authority in the past three (3) years.
 - c. The Prime Contractor has: (a) not been found in default, (b) has not had a valid claim made against a performance bond, and (c) the performance bond has not been called, on ANY project in the past three (3) years.
 - d. The Prime Contractor has not had any business, contracting or trade license, registration, or other certification revoked or suspended in the past three (3) years.
 - e. The Prime Contractor and its Principal/Owners (including any other names, Doing Business As (DBA), or other corporate entity) have not been convicted of any crime relating to its contracting business, in the past ten (10) years.
 - f. Within the past three (3) years, the Prime Contractor has not been found in violation of any law applicable to its contracting business, including but not limited to, licensing, tax laws, prompt payment laws, wage and hour laws, prevailing wage laws, environmental laws or others, where a result of such violation was a payment of a fine, back pay damages or any other type of penalty in the amount of \$5,000 or more.
 - g. The Prime Contractor will employ sufficient numbers of craft labor personnel required to successfully perform the Work it self-performs or shall use qualified Subcontractors to meet this requirement and shall assign workers to perform only work in their respective craft or trade for which they have sufficient skills and training or shall use qualified subcontractors to meet this requirement.
 - h. The Prime Contractor shall pay all craft employees performing the work, at a minimum, the applicable wage and fringe benefit rates, as established for the classification in which the worker is employed, in accordance with 43 PA. Cons. State. 165-1 *et. Seq.*
 - i. The Prime Contractor has all other technical qualifications and resources, including equipment, personnel, and financial resources, to successfully perform the Work and shall maintain such capabilities throughout the duration of the project, or will obtain same through the use of qualified, responsible, subcontractors.
 - j. The Prime Contractor shall assign a full-time project manager and superintendent for the duration of the work. Resumes shall be provided as part of the Contractor Qualification process. Neither the project manager or the superintendent shall be substituted unless written authorization is obtained from the owner and project architect.
 - k. The Prime Contractor shall notify the Owner within seven (7) calendar days of any material changes in its operation that relate to any matter attested to in this certification.
 - l. The Prime Contractor understands that the Qualified Contractor Certification Form shall be executed by a person who has sufficient knowledge to address all matters

in the certification and shall include an attestation stating, under the penalty of perjury, that the information submitted is true, complete, and accurate.

3. Execution of the Qualified Contractor Certification Form shall not establish a presumption of contractor responsibility, and the Owner may require additional information it deems necessary to evaluate the Prime Contractor's status as a qualified and responsible contractor, including information regarding the Prime Contractor's technical qualifications, financial capacity or other resources and performance capabilities. The Owner may require that such information be included in a separate Statement of Qualifications and Experience or as an attachment to the Qualified Contractor Certification Form.
4. The Prime Contractor shall stipulate in the Qualified Contractor Certification Form that, if it receives a Notice of Intent to Award Contracts, it will provide a list of major subcontractors and required subcontractor information before issuance of the Notice to Proceed.
5. If the Prime Contractor, or its Principal/Owners, have ever operated under another name or is controlled by another company or business entity or in the past ten (10) years, controlled or was controlled by another company or business entity, whether a parent company, DBA, subsidiary or in any other business relation, it shall attach an appendix to its Qualified Contractor Certification Form that explains in detail the nature of such relationship. Additional information may be required from such an entity if the relationship in question could potentially impact performance of the Work.
6. If the Prime Contractor fails to provide a Qualified Contractor Certification Form it shall be disqualified from bidding. No action of any nature shall be taken against the Owner because of its refusal to accept a bid for this reason.

1.5 MAJOR SUBCONTRACTOR RESPONSIBILITY REQUIREMENTS

- A. Within five (5) business days of receiving a Notice of Intent to Award, the Prime Contractor shall submit to the Owner a list of Major Subcontractors, which provides the name and address of the Major Subcontractors it will use to perform the Work, the scope of the Work assigned to each, approximate percentage of total Prime Contract value for each.
- B. At the time a Prime Contractor submits the list of Major Subcontractors, it shall also submit Qualified Contractor Certification Form and applicable supporting information for all listed major subcontractors. Qualified Contractor Certification Form shall be executed by the respective major subcontractors on forms provided and shall contain the same information, representations, and supporting information required in the Contractor Responsibility Certification form.
- C. The Prime Contractor shall not be permitted to use a Major Subcontractor to perform the Work unless it has identified the Major Subcontractor on its Subcontractor List and provided a Qualified Contractor Certification Form, or substitution of the Major Subcontractor is approved by the Owner.
- D. The Prime Contractor shall determine whether any Major Subcontractor on its subcontractor list is organized as a sole proprietorship owned and operated by a single person. This shall apply to subcontractors at any tier. For any such entity, the Prime Contractor shall ensure that the sole proprietorship subcontractor is a legitimate business entity and not a misclassified employee by requiring the subcontractor to supplement its Qualified Contractor Certification Form with its Employee Identification and copies of any licenses, certificates, or registrations it is required to maintain in order to do work in the state in which it is located.

- E. A Subcontractor on a Prime Contractor's Major Subcontractor List shall not be substituted unless written authorization is obtained from the Owner and a Qualified Contractor Certification Form is provided for the substitute subcontractor.
- F. In the event that the Owner determines that a Major Subcontractor fails to meet the requirements of the specifications, or is otherwise determined to be non-responsive, it may, after informing the Prime Contractor, exercise one of the following options:
 - 1. Permit the Prime Contractor to substitute a qualified, responsible subcontractor in accordance with the requirements of the specifications, upon submission of a completed Qualified Contractor Certification Form for the substitute and approval of the substitute by the Owner.
 - 2. Require the Prime Contractor to self-perform the Work in question if the Prime Contractor has the required experience, licenses, and other qualifications to perform the work in question; or
- G. In the event that a Major Subcontractor is disqualified, any costs incurred by the Prime Contractor as a result of the disqualification of a Major Subcontractor shall be the responsibility of the Prime Contractor. The Prime Contractor shall not be permitted to make any type of claim against the Owner based on the Major Subcontractor's disqualification.

1.6 QUALIFIED CONTRACTOR REVIEW AND DETERMINATION

- A. Upon issue of the Notice of Intent to Award to the lowest responsive bidder, the Owner shall undertake a Contractor Qualification review process to determine whether the Prime Contractor is a qualified, responsible contractor, in accordance with the specifications and other applicable laws and regulations. The time frame to conducting this review process shall be determined by the Owner.
- B. As part of the review process, the Owner shall ensure that the Qualified Contractor Certification Form and those for each Major Subcontractor and applicable supporting information comply with the requirements of the specifications.
- C. The Owner may conduct any additional inquiries to verify that prospective Prime Contractors and their major subcontractors have the technical qualifications and performance capabilities necessary to successfully perform the Work and that the Prime Contractor has a sufficient record of law compliance, integrity, and business ethics to justify award of a public contract. In conducting such inquiries, the Owner may seek relevant information from the Prime Contractor, its prior clients or customers, its subcontractors, or any other relevant source.
- D. After the Owner determines that all responsibility certifications have been properly executed and has verified that all other relevant information submitted in response to the request pursuant to the review process indicate that the prospective Prime Contractor and its Major Subcontractors are qualified, responsible contractors, the Owner shall issue a written Qualified Contractor Determination for the prospective Prime Contractor.
- E. In the event a Prime Contractor is determined to be unqualified, the Owner shall notify the firm and proceed to conduct a qualification review of the next lowest, responsive bidder or, if necessary, rebid the project. A Contractor Qualification Determination may be revoked at any time if the Owner obtains relevant information warranting such revocation.

1.7 FALSE AND MISLEADING CERTIFICATIONS

- A. If the Owner determines that a Qualified Contractor Certification Form, Subcontractor List, or Major Subcontractor's Qualified Contractor Certification Form contains false or misleading information that was provided knowingly or with reckless disregard for the truth or omits material information knowingly or with reckless disregard of the truth, the Prime Contractor for which the certification was submitted shall be disqualified from the project and shall be prohibited from performing work for the Owner for a period of three (3) years. The Owner may withhold payment of any monies due to the Prime Contractor for damages and impose other applicable penalties and sanctions, including contract termination, as permitted by law or contract.

1.8 EXECUTION OF FINAL CONTRACT

- A. A contract subject to this specification shall not be executed until all requirements of this specification have been fulfilled and until Contractor Qualification Determination or Notice of Intent to Award has been issued by the Owner. Upon completion of all requirements, the Owner may execute a final contract based upon Notice of Intent to Award.
- B. Prior to the execution of a final contract, the Owner shall make available upon request Qualified Contractor Certification Forms, Major Subcontractor Lists, related supporting documentation, and the Contractor Qualification Determination. Confidential information regarding the Prime Contractor's financial statements, subcontract values or percentages, and any protected or patented means and methods will not be subject to public disclosure.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013120

QUALIFIED CONTRACTOR CERTIFICATION FORM

PROJECT NAME: Lower Pottsgrove Township Municipal Building & Police Station

PRIME CONTRACT or SUBCONTRACT: _____

(Complete a Separate Form for each Prime Contract you are Bidding)

Contractor Name: _____ Date: _____ 20____

Contractor Address: _____

_____ Zip Code _____

Contact Name: _____ Email: _____

Contact Direct Phone: _____ Fax: _____

Each Bidding Prime Contractor and its major Subcontractors are required to respond to all questions below. Refer to Specification "013120 – Qualified Contractors" for additional guidance. For the purposes of this certification, the term "Contractor" shall be understood to include any Prime Contractor or Subcontractor business entity including alternate or predecessor businesses entities. It shall also include Principals, Owners and Corporate Officers, and shall apply to such individuals while in the employ of any business entity providing similar services for the stated time duration from the date of this certification.

	YES	NO
1. Does the Contractor and its applicable employees all have valid, effective licenses, registrations, or certificates required by Federal, State, County, or Local law, or required by Specifications, including, but not limited to, licenses, registrations, or certificates required to: (a) do business in the designated locale; and, (b) perform the contract work it seeks to perform? These shall include, but not limited to, licenses, registrations, or certificates for any type of construction or maintenance trade work or specialty work which the firm proposes to self-perform.	☐	☐
2. Does the Contractor meet the bonding requirements for the contract, as required by applicable law or contract specifications, and any insurance requirements, as required by applicable law or contract specifications, including general liability insurance, workers compensation insurance, and unemployment insurance?	☐	☐
3. Has the Contractor or its principals/owners been debarred by any Federal, State, or Local Government agency or authority in the past three (3) years?	☐	☐
4. Has the Contractor defaulted on any project, including action taken on the Performance Bond, in the past three (3) years?	☐	☐
5. Has the Contractor had any type of business, contracting or trade license revoked or suspended by any government agency or authority in the past three (3) years?	☐	☐
6. Has the Prime Contractor or its principals/owners been convicted of any crime relating to the contracting business in the past ten (10) years?	☐	☐

	YES	NO
7. Has the Prime Contractor within the past three (3) years been found in violation of any law applicable to its contracting business including, but not limited to, licenses laws, tax laws, prompt payment laws, wage and hour laws, prevailing wage laws, environmental laws, or others where the result of such violation was the payment of a fine, back pay damages, or any other type of penalty in the amount of \$1,000 or more?	☐	☐
8. The Prime Contractor will pay all craft employees that it employs on the project the current wage rates and fringe benefits as required under applicable Federal, State, or Local wage laws.	☐	☐
9. The Prime Contractor will employ craft employees in all classifications and individual trades required to successfully perform the work related to this project.	☐	☐
10. The Prime Contractor has all other technical qualifications and resources to perform the referenced contract, or will obtain same through the use of qualified, responsible Contractors.	☐	☐
11. The Prime Contractor will maintain all qualifications, resources, and capabilities referenced in this Certification throughout the duration of the project.	☐	☐
12. The Prime Contractor shall notify the Owner within seven days of any material changes to all matters attested to in this Certification.	☐	☐
13. The Prime Contractor understands that the <i>Contractor Responsibility Certification</i> required by this section shall be executed by a person who has sufficient knowledge to address all matters in the Certification and shall include an attestation stating, under the penalty of perjury, that the information submitted is true, complete, and accurate.	☐	☐
14. Attach resumes for the Project Manager and Site Superintendent to be assigned to the Project. Include a detailed description of similar project experience.	☐	☐

ATTACH ADDITIONAL SHEETS, IF NECESSARY

Prime Contractor Authorized Representative: _____
Typed/printed name

Signature: _____

Title: _____ **Date:** _____

NOTARY

State of: _____ County of: _____

Signed and sworn to before me this ____ day of _____

Notary Signature

My commission expires: _____

SECTION 011000 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work by Owner.
4. Work under separate contracts.
5. Owner related products.
6. Use of premises.
7. Coordination with occupants.
8. Work restrictions.
9. Work scope and coordination.
10. Work sequence.
11. Information required before starting work.
12. Specification and drawing conventions.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for project work scopes relating to each Prime Contract.
2. Section 013100 "Project Management and Coordination" for general coordination requirements.
3. Section 013200 "Construction Progress documentation" for preparation of schedules.
4. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
5. Section 016000 "Product Requirements" for storage of Owner Related Products.

1.2 PROJECT INFORMATION

A. Project Identification:

1. Project Title: Lower Pottsgrove Municipal Building & Police Station.
2. Project Location: 1963 East High Street, Pottstown, PA 19464.

B. Owner:

1. Lower Pottsgrove Township, Montgomery County, Pennsylvania
2. Edward Wagner, MPA, Township Manager
3. 2199 Buchert Road, Pottstown, PA 19464.
4. 610.323.0436
5. EWagner@lowerpottsgrove.org

C. Owner's Agent:

1. Providence Consulting Associates, LLC.
2. Christopher Caggiano, President
3. 772 Borough Line Road, Collegeville, PA 19426.
4. 610.310.1759
5. CCaggiano1@gmail.com

- D. Architect:
1. MG Architects, Ltd.
 2. Scott O. Graham, AIA, LEED AP BD+C, Principal.
 3. 1268 Penn Avenue, Wyomissing, PA 19610.
 4. 610.376.4927
 5. ScottG@MG-Architects.com
- E. Architect's Consultants: Architect has retained the following design professionals who have prepared or contributed to the preparation of portions of the Contract Documents:
1. Structural Engineer:
 - a. Di Genova Associates, Inc.
 - b. 1212 Germantown Pike, Suite 5, Plymouth Meeting, PA 19462
 - c. 610.270.9511
 - d. Sam Di Genova, P.E.
 - e. SDiGenova@DiGenovaAssociates.com
 2. Mechanical & Electrical Engineer:
 - a. Martarano Associates
 - b. 1105 Berkshire Blvd., Suite 140, Wyomissing, PA 19610
 - c. 484.706.9779
 - d. Angelo L. Martarano, P.E.
 - e. AMartarano@martaranoengineering.com
- F. Owner's Consultants: Owner has retained the following design professionals who have prepared or contributed to the preparation of portions of the Contract Documents:
1. Civil Engineer:
 - a. McCarthy Engineering Associates, Inc.
 - b. 1011 N Park Road, Suite 100, Wyomissing, PA 19610
 - c. 610.373.8001
 - d. James McCarthy, P.E.
 - e. JMcCarthy@mccarthy-engineering.com

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by Contract Documents and consists of the following:
- B. Type of Contract:
1. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a description of work included under each of the multiple contracts and for the responsibilities of Project Coordinator. Contracts for this Project include the following:
 - a. Contract No. 23-0047.0-1: General Construction Work (GC).
 - b. Contract No. 23-0047.0-2: HVAC/Mechanical Work (HC).
 - c. Contract No. 23-0047.0-3: Electrical Work (EC).
 - d. Contract No. 23-0047.0-4: Plumbing Work (PC).

1.4 WORK BY OWNER UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with 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 separate contracts.
1. Movable Furniture and Furnishings
 2. High Density File Storage System (1st Floor)
 3. Parking Lot Restriping
 4. Monument Sign demolition and construction
 5. Information Technology Equipment
 6. Audio/Visual Equipment
 7. Access Control, Security and Duress Systems Equipment
 8. HVAC System Testing and Balancing
 9. Geotechnical Investigations

1.5 OWNER-RELATED PRODUCTS

A. Owner Furnished – Contractor Installed Products:

1. Owner will furnish products indicated. Contractor shall receive, unload, handle, store, protect, and install Owner-furnished products and make building services connections.
2. Owner-Furnished Products:
 - a. Kitchenette Appliances – General Contractor to receive, unload, handle, store, protect, and install all kitchenette appliances as indicated on the project drawings. Mechanical, Plumbing, and Electrical Contractor to provide, install, and perform all building service connections to appliances that fall under their trade. All Prime Contractors are required to coordinate with Owner on which appliances are being provided and verify work required prior to install.
 - b. Owner shall provide consumable toilet room material dispensers as noted in Construction Drawings. General Contractor shall provide blocking for and install dispensers at locations noted in Drawings.
 - c. Owner shall provide emergency keybox to be installed on building at location to be determined by AHJ. Box shall be recessed into existing or new masonry façade. Owner shall also provide keyed-alike emergency pad-locks to be installed on all construction fences daisy-chained to contractor locks.

B. Owner Provided Products:

1. Owner will provide products indicated. Contractor shall provide adjacent materials as required by Contract Documents leaving conditions ready for Owner provided products. Owner or its vendors shall install.

2. Owner provided products:
 - a. High Density Rolling Storage System
 - b. Security and Duress System Equipment
 - c. Audio/Visual Equipment
 - d. Information Technology Equipment
3. See Section 011200 "Multiple Contract Summary" for coordination narratives related to items listed in previous paragraph.

1.6 USE OF PREMISES

- A. General: The Project site is defined as the area, including buildings, contained within the Limits of Construction. The Limits of Construction are identified on the Contract Drawings. Contractor shall have full use of Project site for construction operations during construction period, except as limited below. Contractor's use of Project site also is limited by Owner's right to perform work or to retain other contractors on portions of Project.
- B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Limits on Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 1. Limits: Confine construction operations to areas shown on the Contract Drawings, Site Logistics Plan, and indicated through other instructions by the Owner.
 2. Driveways, Walkways and Entrances: Keep driveways, loading areas, walkways, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Use designated entrance(s) only for deliveries and site access.
 - b. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - c. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 3. No staging of deliveries, equipment, or materials or parking is allowed outside of the Limits of Construction – to include the adjacent roadways.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather tight condition throughout construction period. Repair damage caused by construction operations.
- E. Elevator: Use of existing elevator shall be permitted up until its upgrades and refurbishment. General Contractor shall be responsible for maintaining elevator in good working order, and be responsible for any damage incurred or required repairs due to use during construction activities.

1.7 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such limited occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work. Prior to limited occupancy:
1. When required by schedule, Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work, including a punch list for each such portion of the Work.
 2. Contractor will obtain a Certificate of Occupancy, or other form of authorization, from authorities having jurisdiction.
 3. Mechanical and electrical systems serving the area of limited occupancy shall be fully operational, and required tests and inspections shall be successfully completed. Upon limited occupancy, Owner will accept, operate and maintain mechanical and electrical systems serving area of limited occupancy; any such mechanical and electrical systems work that is incomplete, or identified on a punch list, shall remain the responsibility of Contractor to operate and maintain until complete.
 4. Upon occupancy of the area of limited occupancy, Owner will assume responsibility for maintenance and custodial service for such portions of the Work.
 5. Contractor shall remain responsible for correcting all punch list items, protection of work, and daily and final cleanup, until all punch list items have been corrected to the satisfaction and acceptance of the Architect.

1.8 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
 2. Comply with all Township Ordinances for noise, etc. – to include deliveries, dumpster pickup/dropoff, idling vehicles, and construction activities.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated.
1. Weekend Hours: Work on Saturdays and Sundays shall be permitted with a twenty-four (24) hour advance notice in writing.
 2. Early Morning Hours: Only upon approval by Owner or Architect, construction activities may commence no earlier than 6:00 a.m. Activities shall comply with all local noise ordinances.
 3. Late Evening/Night Hours: Only upon approval by Owner or Architect, but no later than 9:00 p.m. Activities shall comply with all local noise ordinances.
 4. Hours for Utility Shutdowns: Only upon approval by Owner with a twenty-four (24) hour advance notice in writing.
 5. Hours for Core Drilling, Pneumatic Hammering or Similar Noisy Activity: Limited to normal business working hours as defined above.
- C. Nonsmoking Building: For both new construction/additions work, and renovation work, smoking is not permitted within the building, on the building roofs or within 50 feet of entrances, operable windows, or outdoor-air intakes, regardless of whether or not such locations are on Owner or public property.

- D. Controlled Substances: Use of controlled substances – to include but limited to alcohol, drugs, and guns - on either the Project site, or elsewhere on Owner property, is not permitted. All offending individual(s) will be instructed to immediately leave Owner property and the local authorities will be contacted. The offending individual(s) that return to the Project will be subject to the policies and procedures of the Owner.

1.9 WORK SCOPE AND COORDINATION

- A. Unless Contract Documents indicate otherwise, neither naming, identification nor organization of Drawings and Specifications are intended to establish which Contractor, trade or subcontractor is responsible for any specific element of Work. Each Prime Contractor shall review ALL drawings and relevant specifications to fully comprehend its scope of work.
1. Quality assurance requirements, local custom and trade-union jurisdictional settlements notwithstanding, each Contractor has sole discretion in allocating and coordinating work elements among subcontracts, except as follows:
 - a. When a potential jurisdictional dispute or similar interruption of work is first identified or threatened, Contractor shall take reasonable measures to avoid or minimize interruption and delays.
 - b. Observe specified requirements for manufacturers, substitutions and source limitations.
 2. Perform Work specifically depicted and described by or reasonably inferable from Contract Documents as work necessary to produce intended results of Construction Contract.
- B. Unless otherwise indicated, the Work described shall be complete systems and assemblies, including products, components, accessories, and installation required by Contract Documents.
1. Each Prime Contractor shall coordinate its work with that of all other Prime Contractors including field modifications and adjustments as warranted.
 2. Each Prime Contractor shall maintain a marked-up field copy of the drawings and specifications containing all changes from original construction drawings applicable to its scope of work.
 3. Coordinate Work with that of Owner, including Owner's other contractors, agents or consultants, including access and performance of personnel and equipment, staging and storing of tools and materials, sequencing of operations, and use and maintenance of temporary facilities including shoring and scaffolding.
 4. Participate in and cooperate with quality assurance and quality control activities required on the project.
 5. Observe requirements and procedures for site safety and security measures, daily and periodic cleaning, personnel behavior, worker and delivery access, daily materials delivery, and Owner's continued occupancy and use of sites adjacent to Project areas.
 6. Modifications to the Work made necessary by Contractor's failure to properly coordinate the Work, shall be made by Contractor, at no additional cost to Owner.
 7. Verify that Subcontractors involved with the Work have appropriate Certificates of Insurance on file with Owner.
 8. Verify Subcontractor compliance with applicable conditions of the Prevailing Wage Act.

1.10 WORK SEQUENCE

- A. Project will commence after approvals from authorities having jurisdiction have been received, and the Notice to Proceed has been issued.
- B. The following critical dates represent minimum requirements for Owner's timely use of the facility.
 - 1. Site available for site survey and measurement: After Notice to Proceed is issued and work is coordinated with Lead Prime Contractor.
 - 2. Assumed Notice to Proceed: On or about October 24, 2024
 - 3. Assumed Construction Start: On or about November 25, 2024
 - 4. Assumed Substantial Completion: October 31, 2025
 - 5. Full and Final Completion: 30 days past Substantial Completion date.
- C. Fabrication and delivery of key equipment and materials to site to support required completion dates is essential. Contractor shall include in its bid any cost to expedite submittals and delivery of key materials and equipment by dates required to meet Construction Schedule. No additional costs will be considered for expediting materials or equipment to meet required schedule.
- D. Each Contractor shall include in the bid cost of preparing for and attending specified periodic coordination meetings, minimum weekly, starting immediately following Contract Award. Key subcontractors are also to include this cost in their bids for their participation in these coordination meetings. Purpose of these coordination meetings will be to assure that submittals, reviews, and materials and equipment are delivered by required dates, and to coordinate the Work.
 - 1. Refer to Specification 013100 for the complete Prime Contractor responsibilities for meeting attendance and participation.

1.11 INFORMATION AND ACTIONS REQUIRED BEFORE STARTING WORK.

- A. Receipt and acceptance/approval of the following information is a condition precedent to and payment under this Contract.
 - 1. Receipt and acceptance/approval is not a condition precedent to payment for Bonds and Insurance, as further described at Section 012900.
- B. Submit the following as required by this Section, Document 005200 "Standard Form of Agreement Between Owner and Contractor," Document 007200 "General Conditions", Document 007201 "Supplementary Conditions of the Contract", Section 011000 "Summary of Work", and Section 011200 "Multiple Contract Summary".
 - 1. Executed Contract, and forms and certificates required by the Agreement.
 - 2. Insurance Certificates.
 - 3. Trade Permits.
 - 4. Other permits required by authorities having jurisdiction.
 - 5. Contractor licenses as required by authority having jurisdiction.
- C. Submit the following as required by Section 013100 "Project Management and Coordination."
 - 1. Subcontractors List.

2. Key Personnel Names and contact information
- D. Submit the following as required by Section 013200 "Construction Progress Documentation."
 1. Startup Construction Schedule.
- E. Submit the following as required by Section 013300 "Submittal Procedures."
 1. Submittal Schedule.
- F. Submit the following as required by Section 012900 "Payment Procedures."
 1. Schedule of Values.
- G. Safety Procedures Manual: One copy of this plan will be held on site in Lead Prime Contractor's field office.
 1. Submit an OSHA compliant Safety Procedures Manual that identifies site-specific safety issues related to Contractor's work and detail how each will be addressed.
 2. Include Safety Data Sheets (SDS) for potentially hazardous substances that will be used in performing the work scope.
 - a. Hazardous Substance Survey Form: Submit an outline of SDS applicable to this project.
 - b. Update SD inventory log weekly.

1.12 PROJECT COMMUNICATIONS

- A. All communication with Owner shall flow through the Architect. In the event of such communications, any directions or decisions made by Owner shall be considered to be unenforceable unless formalized in written correspondence from the Architect. All correspondence shall be addressed primarily to the Architect.

1.13 PERMITS AND FEES

- A. Owner shall secure and pay for the General Building Permit. Each Prime Contractor shall secure and pay for other permits and governmental fees, licenses, and inspections necessary for the proper execution of and completion of its Contract. Submit copies of all permits and inspection reports to Architect, and post as required. Owner reserves the right to request applicable Prime Contractor to pay for General Building Permit and reimburse the contractor for the fee without any markup to the cost.

1.14 SPECIFICATION AND DRAWING CONVENTIONS

- A. Use of standardized formats and conventions is employed in Contract Documents for purposes of presenting information in a reasonably predictable and consistent manner. Some deviation from standard formats and conventions will occur, but such deviation will by no means release Contractor from performance of the Work depicted.

- B. Specifications Format: Except as noted otherwise, the Specifications are organized into Divisions and Sections using the 50-Division format of CSI/CSC's "MasterFormat" numbering system, 2004 Edition.
1. Some Sections may deviate from CSI/CSC's SectionFormat standard for organizing specification text within a Section.
 2. Section Identification: Consult Table of Contents at beginning of Project Manual to determine numbers and names of Sections in Contract Documents.
 3. Documents in Division 00 that are not specifically excluded from set of Contract Documents, and Sections in Division 01 generally, govern the performance of the Work specified anywhere in Contract Documents.
 4. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all specifications Sections in Project Manual.
- C. Specification Content: Specifications use certain conventions for style of language and intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as context of Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. Words "shall," "shall be," or "shall comply with," depending on context, are implied where a colon (:) is used within a sentence or phrase.
 3. Specification requirements are to be performed by Contractor, unless specifically stated otherwise.
- 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, or where not scheduled, published as part of the U.S. National CAD Standard.
- E. Drawing / Specification Discrepancy:
1. In the event of discrepancy between the work depicted or annotations on the drawings and the specifications, the specifications shall take precedence.
 2. No additional compensation shall be granted to the Contractor in such circumstances.

1.15 SAFETY

- A. Contractor will comply with all OSHA requirements and understands that this project requires Hard Hats, Safety Glasses, High Viz Clothing (Non-reflective) at all times on site. Gloves are required when applicable. Primes are required to provide their work force with PPE.
- B. Each Prime is encouraged to conduct weekly tool box talks.
- C. Workers are to adhere and comply with the safety protocol. The Owner reserves the right to remove any worker refusing to do the screening, wear face masks, or fails to properly report a positive Covid case.

1.16 SITE LOGISTICS PLAN

- A. All contractors acknowledge that the project shall be constructed following the designated Site Logistics Plan and it is their responsibility to coordinate, schedule, and instruct their workers to place all work observing these conditions and those coordinated at the Weekly Planning meeting. All contractors are required to familiarize themselves with the Site Logistics Plan and coordinate their sequencing of the work.
- B. Final Site Logistics details shall be determined by the Lead Prime Contractor based on its understanding of the Work and input from other Prime Contractors.
- C. All contractors acknowledge that the site and interior safety, and logistics plan are subject to change based on the direction of the Owner or circumstances related to schedule, work progress, or other events beyond the control of the Owner.
- D. See Site Logistics Plan contained in the Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 011200 - MULTIPLE CONTRACT SUMMARY (Rev. 1)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. A summary of each contract, including responsibilities for coordination and temporary facilities and controls.
2. Specific requirements for Work of each contract are also indicated in individual Specification Sections and on Drawings.

B. Related Requirements:

1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site,] coordination with occupants, and work restrictions.
2. Section 012500 "Substitution Procedures" for substitutions.
3. Section 013100 "Project Management and Coordination" for general coordination requirements.
4. Section 013200 "Construction Progress Documentation" for scheduling requirements.
5. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 ABBREVIATIONS

A. Abbreviations used in this Section relate to project Contractors and Contracts and are as follows:

1. GC: General Contractor or General Construction Contract.
2. PC: Plumbing Contractor or Plumbing Contract.
3. HC: HVAC Contractor or HVAC Contract.
4. EC: Electrical Contractor or Electrical Contract.

1.3 COORDINATION

A. Project Coordinator shall be responsible for coordination between Owner, Engineering Consultants and Owner's contractors as defined in Section 011000 "Summary of Work".

1. Architect shall act as Project Coordinator.
2. Drawing and Specifications Review: All Prime Contractors shall be responsible for reviewing all contract drawings and specifications for work assigned to their respective contracts. Architectural, Structural and Civil Design drawings and specifications may include scopes of work explicitly assigned to non-GC prime contractors. In such cases, applicable contractors are specified in notation on the drawings.

B. Lead Prime Contractor (LPC) shall act as main contractor for project and be responsible for general coordination among various project contracts.

1. General Contractor shall act as Lead Prime Contractor (unless otherwise noted.)

- C. Lead Prime Contractor: Be experienced in administration and supervision of building construction, including mechanical and electrical work. Coordination activities of Lead Prime Contractor include, but are not limited to, the following:
1. Provide overall coordination of the Work, including work by separate Prime Contractors.
 2. Coordinate shared access to workspaces.
 3. Provide overall coordination of temporary facilities and controls.
 4. Coordinate, schedule, and approve interruptions of permanent and temporary utilities, including those necessary to make connections for temporary services.
 5. Coordinate construction and operations of the Work with that performed by each Contract.
 6. Coordinate Owner required quality-assurance and quality-control services specified in Section 014000 "Quality Requirements."
 7. Provide information necessary to adjust, move, or relocate existing utility structures affected by construction.
 8. Provide experienced field superintendent's name and resume for approval by Owner and Architect.
 9. Provide field surveys of in-progress construction and site work.
 10. Locate existing benchmarks, control points, and similar reference points, and establish permanent benchmarks on Project site.
 11. Coordinate product selections for compatibility.
 12. Coordinate sequence of activities to accommodate tests and inspections, and coordinate schedule of tests and inspections.
 13. Coordinate sequencing and scheduling of the Work, as required by Section 013200 "Construction Progress Documentation," including the following:
 - a. Initial Coordination Meeting: At earliest possible date, arrange and conduct a meeting with separate Contractors for sequencing and coordinating the Work; negotiate reasonable adjustments to project schedules.
 - b. Prepare a Construction Schedule for entire Project. Base schedule on Startup Construction Schedule. Secure time commitments for performing critical construction activities from other Contractors. Show activities of each Prime Contract. Prepare a simplified summary sheet indicating combined construction activities for all Contracts.
 - c. Distribute copies to Architect, Owner, and separate Contractors of completed Construction Schedule approved and signed by all Contractors.
 - d. Submit a final Construction Schedule signed by project Contractors prior to first payment application.
 - e. If Lead Prime Contractor fails to provide CPM Construction Schedule as required, Owner will provide Construction Schedule and deduct associated costs from LPC's Contract sum.
 - f. Provide Construction Schedule updates as required.
 14. Provide progress cleaning of common areas and coordinate progress cleaning of areas or pieces of equipment where more than one Contractor has worked.
 15. Coordinate following actions that are to be taken by each Contractor as is required to complete their Work:
 - a. Cutting and patching.
 - b. Firestopping.
 - c. Protection of the Work.
 - d. Completion of interrelated punch list items.

16. Coordinate preparation of Project Record Documents if information from more than one Contractor is to be integrated with information from other Contractors to form one combined record.
- D. Mechanical/Electrical/Plumbing/Fire Protection (MEP-FP) systems shall be under direction of MEP Coordinator whom shall be responsible for coordination between the Fire Protection Contract, Plumbing Contract, HVAC Contract, and Electrical Contract.
 1. HVAC Contractor shall act as MEP Coordinator.
- E. MEP Coordinator: Coordination activities of MEP Coordinator include, but are not limited to, the following:
 1. Coordinate schedule and sequence of mechanical, electrical, and plumbing activities.
 2. Coordinate sharing access to workspaces by mechanical, electrical, and plumbing contractors.
 3. Coordinate integration of mechanical, electrical, and plumbing work into limited spaces.
 4. Coordinate protection of mechanical, electrical, and plumbing contractors' work.
 5. Coordinate cutting and patching for mechanical, electrical, and plumbing work.
 6. Coordinate preparation of mechanical, electrical, and plumbing coordination drawings.
 7. Coordinate tests and inspections for mechanical, electrical, and plumbing work.
 8. Coordinate mechanical, electrical, and plumbing temporary services and facilities.

1.4 GENERAL REQUIREMENTS OF CONTRACTS

- A. Extent of Contract: Unless the Contract Documents contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which Contract includes a specific element of Project.
 1. Local custom and trade-union jurisdictional settlements do not control the scope of the Work of each contract. When a potential jurisdictional dispute or similar interruption of work is first identified or threatened, affected Contractors shall negotiate a reasonable settlement to avoid or minimize interruption and delays.
 2. Perform Work specifically depicted and described by, or reasonably inferable from, the Contract Documents as work necessary to produce intended results of respective Construction Contract. Commonly recognized names and terminology on Drawings and in Specifications may reasonably be used to infer which contract includes a specific element of the Project.
 3. Requirements and Specifications of Project Manual applicable to all Contracts:
 - a. Contract Documents of Division 00 - Procurement and Contracting Requirements.
 - b. Sections of Division 01 - General Requirements.
- B. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
 1. Each Contractor is responsible for verification of existing conditions.
 2. Each Contractor is responsible for compliance with Americans with Disability Act Accessibility Guidelines, ADAAG, as relating to its work scope.
 3. Trenches and Excavation: Provide by each contract for its own Work.
 4. Blocking and Backing Panels: Work for each Contract shall be by General Contractor.

- a. Other Contractors that require blocking to support their work shall submit drawings showing location and extent of blocking to General Contractor seven (7) days prior to scheduled start of framing.
 - 5. Sleeves and Metal Fabrication Supports: Work for each Contract shall be Contractor requiring Sleeves and Metal Fabrication Supports, unless noted otherwise.
 - a. For Sleeves and Metal Fabrication Supports set in masonry and concrete work by General Contractor, Contractor requiring Sleeves and Metal Fabrication Supports shall furnish Sleeves and Metal Fabrication Supports, and drawings showing location of each Sleeve and Metal Fabrication Support to General Contractor 7 days prior to the start of concrete formwork, or 7 days prior to the start of masonry work.
 - b. For all other locations and conditions, Contractor requiring Sleeves and Metal Fabrication Supports shall provide Sleeves and Metal Fabrication Supports, and shall coordinate this work so as not to delay other Contractors in completing their work.
 - 6. Access Panels: General Contractor to provide and install access panels shown on the drawings. Any additional panels required for MEP work by Code or for access/maintenance are to be provided by the respective Prime Contractor and installed by the General Contractor so as to maintain the integrity of the finished work.
 - a. Other Contractors shall submit drawings showing panel locations, sizes, and framing requirements to General Contractor within 30 days of Notice to Proceed.
 - b. Refer to specifications for access panel types for each type of construction.
 - 7. Equipment Pads: Provide by each Contract for its own Work.
 - 8. Roof-Mounted Equipment Curbs: Furnish by each Contract for its own Work and give to General Contractor for installation on roof deck.
 - 9. Field Painting: Work of each Contract shall be the work of General Contractor.
 - 10. Cutting and Patching: Provide by each Contract for its own Work.
 - 11. Firestopping: Provide by each Contract for its own Work.
 - 12. Caulking: Provide by each Contract for its own Work. Coordinate between Contractors for proper and consistent installation.
- C. Firestopping: Each prime shall provide fire-stopping materials and installation for its own Work. Primes shall coordinate and agree upon a single fire-stopping systems vendor, or to fewest vendors possible, and submit as a delegated design submission to Architect for review by Authority Having Jurisdiction.
- D. Project Coordination:
- 1. Each Contractor shall participate in and cooperate with coordination activities of Lead Prime Contractor, MEP Coordinator and other Contractors. Perform Work in support of most recent updated and approved Construction Schedule, Submittals Schedule, and applicable Coordination/Shop Drawings to maintain required sequence and overall progress of project.
 - a. Provide information requested by Lead Prime Contractor in preparation of Construction Schedule, including time commitments for critical activities.
 - b. Prepare for and attend scheduled project update, coordination and pre-installation meetings, and other project meetings.

2. Coordinate Work with that of other Contractors and work by Owner, including access and performance of personnel and equipment, staging and storing of tools and materials, sequencing of operations, and use and maintenance of temporary facilities and services.
 - a. Modifications to the Work made necessary by a Contractor's failure to properly coordinate the Work, or costs incurred by a Contractor as a result of such failure, shall be the responsibility of that Contractor. No additional cost shall be incurred by Owner for such failure.
3. Participate in and cooperate with quality assurance, testing and inspection activities of Lead Contractor, Owner and other Contractors.
4. Participate in and cooperate with closeout activities and procedures of Lead Contractor and Architect.
5. Participate in and cooperate with requirements and procedures for site safety and security measures, daily and periodic cleaning, personnel behavior, worker and delivery access, daily materials delivery, and Owner's continued occupancy and use of sites adjacent to Project areas (if applicable).
6. Participate in and cooperate with all Special Inspections being done by Owner's Special Inspections Testing Agency.

E. Logistics:

1. Requirements for use of building and site for specific activities are indicated in Contract Documents and in Phasing and Logistics Plans, and are intended to allow for Owner's continued use of site and facilities during project time, and to allow the Work to proceed uninterrupted during project time.
2. It is responsibility of each Prime Bidder to review logistics requirements prior to bid to fully understand proposed sequencing, restrictions and durations. There will be no extensions of time on the project due to Contractor not fully understanding logistics requirements.
3. Deviations from specific logistics requirements may be approved, with prior written approval from Owner and Architect and properly coordinated with all Contracts, only if there is no adverse impact on Owner's intended continued use of facility and no additional cost to Owner, or to any Contractor.
4. Each Contractor shall be responsible to protect, maintain, extend, repair, restore, or otherwise keep functional all building systems in or serving occupied spaces that may be interrupted or disturbed by construction activities or by phasing relocations or restrictions.

F. Recovery Plan: There will be no extensions of time on the project; it is of the essence of the Contract that Substantial Completion be achieved as required by Contract. If it becomes apparent that a Contractor will not meet one of agreed-upon critical milestones, or the date for Substantial Completion, that Contractor shall immediately institute a Recovery Plan. Some or all of following shall be employed at no additional cost to Owner:

- a. Increase manpower.
 - b. Increase man-hours per shift, shifts per workday, days per work week, or any combination thereof. Additional cost for Architect, Construction Manager, or Owner for overtime or shift work shall be borne by Contractor.
 - c. Increase construction equipment or expedite material deliveries.
 - d. Revise scheduled sequencing of Contractor's tasks to put project back on schedule.
2. If Contractor fails to institute a recovery plan within 24 hrs from written notice, which will return project to original schedule, appropriate action may be taken involving contractual commitments and performance bonds.

3. Costs for any recovery plan shall be anticipated by Contractor and included in its Base Bid. If Contractor fails to return project to original schedule, Contractor shall be responsible for developing a Recovery Schedule as described in Section 013200. Contractor shall be responsible for all costs incurred by other Contractors, and by Owner, resulting from the development and implementation of a Recovery Schedule.
- G. Substitutions: Each contractor shall cooperate with other Contractors involved to coordinate approved substitutions with remainder of the work.
1. Contractor initiating or requesting Substitution shall be responsible for coordinating substitution's installation requirements with other affected Contractors. If other Contractors incur costs (direct or indirect) as a result of the substitution, the Contractor initiating substitution shall be responsible for all costs incurred by other Contractors. Owner shall incur no additional costs as a result of substitution.
 2. Any costs incurred by Architect as a result of Substitution shall be paid for by Contractor initiating the substitution.
 3. Use by any Contractor of products, systems, or assemblies other than those identified as Basis-of-Design, whether or not approved as Substitution, shall not result in additional cost to Owner, Architect, Construction Manager or other Contractors. Contractor employing such substitutions, whether or not approved, shall be subject to a reduction in Contract Sum to compensate for charges so incurred by Owner, Architect or other Contractors.
 4. Substitutions shall be made in accordance with the requirements of Section 012500 "Substitutions."
- H. Temporary Utilities and Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Sections 015100 "Temporary Utilities" and 015200 "Temporary Facilities and Controls," each Contractor is responsible for the following:
1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility.
 2. Plug-in electric power cords and extension cords, and any lighting required by Contractor that is not provided for in Section 015100 "Temporary Utilities" for its own field office, complete with necessary furniture, utilities, and telephone service.
 3. Its own storage and fabrication sheds.
 4. Temporary enclosures for its own construction activities.
 5. Hoisting facilities for its own construction activities.
 6. Staging, scaffolding, and shoring for its own construction activities.
 7. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials, and as required by Sections 015200 "Temporary Facilities and Controls" and 017300 "Execution."
 8. Progress cleaning of work areas affected by its operations on a daily basis.
 9. Secure lockup of its own tools, materials, and equipment.
 10. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
- I. Temporary Heating, Cooling, and Ventilation: Requirements, restrictions and responsibilities as required by Section 015100 "Temporary Utilities".

- J. Site Utilities: Where site systems are defined as that part of building systems extending five feet beyond the building line, responsibility for providing site utilities and structures, including trenching and backfilling, shall be as follows, unless otherwise specified on the project drawings:
1. General Construction Contract: Storm and sanitary sewers.
 2. Plumbing Contract: Natural gas, domestic water, fire protection water.
 3. Electrical Contract: Electric Power Service, cable, and communications.
- K. Municipal Permits, Registrations, Certifications, and Inspections:
1. Owner shall pay for the Building Permit.
 - a. If deemed necessary for the expedient commencement of the Work and at the discretion of the Owner, the General Contractor shall pay for the Building Permit at time of pickup. The Owner shall directly reimburse the Contractor AT COST within two weeks of presentation of receipt.
 2. All Contractors: Obtain and pay for required local licenses, permits, and inspections.
 3. General Construction Contract: Obtain and pay for elevator permits and associated inspections.

1.5 OWNER PROVIDED EQUIPMENT COORDINATION

A. HIGH-DENSITY FILE STORAGE NARRATIVE:

1. GC to dismantle and relocate existing 1st floor rolling high-density file storage system.
2. GC to reconstruct and install salvaged high-density file storage system in new location on 2nd floor plan including finished floor shims for length of floor rails.
3. Owner's vendor shall be responsible for installation of new high-density file storage system on 1st floor.
 - a. GC shall provide finished floor shims for length of floor rails.

B. ACCESS CONTROL, ELECTRONIC DOOR HARDWARE AND SECURITY EQUIPMENT NARRATIVE:

1. The following outlines Owner and Prime Contractor responsibilities for installation and coordination of Owner-provided Access Controls, Door Hardware and Security equipment.
2. EC shall provide the following:
 - a. Back boxes and conduit to ceiling plenums from boxes and wiring location at door jams including extensions of any device wiring necessary to reach ceiling plenum. Conduit shall be used by Owner's Security Vendor (OSV) for wiring card access hardware.
 - b. Provide data and power to local security network hubs near wireless card access locations.
 - c. Backboxes, covers, conduit to ceiling plenums from boxes, data wiring and terminations to security device locations.
3. OSV shall provide the following:
 - a. Card reader panels/sensors and covers.
 - b. Key cards/fobs.

- c. Power supplies and wiring from plenum locations to supply locations.
 - d. Remote door release switches and wiring to door locations.
 - e. Provide programming and integration.
 - f. Shall provide coordination with and review of GC-provided hardware to verify compatibility with systems.
4. GC shall provide the following:
 - a. All necessary door and frame prep for GC-provided hardware.
 - b. Electronic door locksets w/ latchbolt monitoring (including any wireless lockset units).
 - c. Power transfers.
 - d. Provide wireless battery-operated, compatible locksets where retrofit of existing doors for wired hardware is infeasible or cost prohibitive.
5. GC, OSV & EC shall coordinate for installation of all security hardware.

C. AUDIO/VISUAL & IT ROUGH-IN AND EQUIPMENT NARRATIVE

1. The following outlines Owner and Prime Contractor responsibilities for installation and coordination of Owner-provided Audio/Visual equipment, wiring and devices.
2. EC shall provide the following:
 - a. Back boxes and appropriately-sized conduits to ceiling plenums from boxes and wiring locations
 - b. Provide Audio/Visual signal wiring and terminations as indicated.
 - c. Coordinate final termination points with Owner's IT vendor.
3. Owner's IT vendor shall provide the following:
 - a. Audio/Visual Equipment including displays, microphone systems, media servers and distribution equipment.
 - b. Information Technology equipment.
 - c. Shall provide coordination with and review of EC-provided work prior to rough-in.

1.6 GENERAL CONSTRUCTION CONTRACT

- A. Work in the General Construction Contract includes, but is not limited to, the following:
 1. Participate in the Architect's electronic document management program; support will be available for the duration of the project.
 2. Engineering, layout, and survey utilizing a Registered Surveyor for the project to facilitate construction. Layout includes establishing building corners and grid lines for the project that all Contractors can work from.
 3. Install and maintain all safety rails per OSHA standards for work required by all contracts. Install safety rail around all elevator openings, stairwells, duct shafts, structure perimeter, and all other sizable openings or fall hazards unable to be protected otherwise. Remove sections of handrail where required by other trades for their work to progress and ensure that remaining safety rail meets OSHA standards. Provide any necessary sets of temporary stairs within the building, to create two means of egress from each floor level and roof. Provide ladder access to all other elevations, including the

- roof for use by all contractors, immediately upon the vertical structural work reaching that elevation. Provide safe egress into the building where required.
4. All work depicted in the drawings and specifications typically ascribed to the General Trades unless specifically noted otherwise.
 5. Firestopping and sealant associated with this work. Penetrations by other trades are to be sealed by that trade.
 6. Framed openings and pipe sleeves in walls and ceilings as located by other trades. Lintels and sleeves for these openings will be furnished by the respective trade requiring the opening, and install by General Construction Prime Contractor. Each respective contractor is responsible for coordinating and locating their openings for the General Construction Prime Contractor.
 7. Perform all dewatering necessary for the site work & building dewatering, for the work to proceed on a daily basis.
 8. Exterior equipment pads, light pole bases, or concrete ductbanks are the responsibility of the contractor providing the equipment or piping. All other exterior concrete is to be provided by the General Construction Prime Contractor.
 9. All asphalt paving placed on stone subbase or milled areas, touch up of stone subbase as needed to accommodate construction traffic between time from stone completion and paving, line striping, signage, and multiple mobilizations to accommodate construction phasing and schedule.
 10. The General Contractor shall maintain, repair, and clean the existing parking lots to original condition and then provide crack-repair and sealcoat over entire surface.
 11. Install all access panels shown on drawings. Install all others furnished by the mechanical, plumbing, and electrical contractors – to include final painting, as applicable.
 12. The GC shall coordinate roof activities with all applicable prime contractors.
 13. The GC is responsible for the labor and material to install the wall-mounted roof canopies, as described in the project drawings.
 14. Roof work to include providing and installing roof blocking and installing equipment curbs. provide all low slope / membrane roof insulation and roofing as indicated on drawings. MEP trades to provide and layout curbs, GC to install all curbs and other roof blocking shown on the drawings, then insulate and install roofing and terminations.
 15. Install MEP equipment curbs. Curbs shall be provided and laid out by respective Prime Contractor. GC to roof and flash over curb.
 16. The GC shall be designated as the Lead Prime Contractor and shall have the responsibility of overall coordination of the work relative to weekly scheduling and the coordination of the lead General Contractor's work fully coordinated with all other Prime Contractors.
 17. General Contractor shall provide and install all site storm sewer, foundation drains, and downspout leader extensions to storm sewer system. Hand-off of storm lines leaving the building is approximately 5 feet from the building, as shown on the drawings. In addition to Work indicated in the "C-Series" Drawings for this project.
 18. GC shall perform all roof deck penetrations and structural reconfigurations as described in the project drawings.
 19. GC shall include modernization scope for existing hydraulic elevator as noted on Architectural drawings. ~~and in Section 142400 "Hydraulic Elevators."~~

B. Refer to following specification Sections applicable to this Contract:

1. All Division 01 Sections.
2. All Division 02 Sections.
3. All Division 03 Sections.
4. All Division 04 Sections.
5. All Division 05 Sections.
6. All Division 06 Sections.
7. All Division 07 Sections.

8. All Division 08 Sections.
9. All Division 09 Sections.
10. All Division 10 Sections.
11. All Division 11 Sections.
12. All Division 12 Sections.
13. All Division 13 Sections.
14. All Division 14 Sections.
15. All Division 31 Sections.
16. Division 32 Sections.

- C. Various Drawings are associated with the Work of this Contract. Each Contractor is obligated to view entire project Drawing Set to ascertain Work of this Contract.

1.7 PLUMBING CONTRACT

- A. Work in the Plumbing Contract includes, but is not limited to, the following:
1. Provide sealants and firestopping as required relating to this work.
 2. Where necessary to disturb the underslab material, return same to condition acceptable to the General Contractor.
 3. Perform all excavation, dewatering, backfill, and compaction testing to install work under this contract.
 4. Protect open ends of installed work by means suitable to prevent entrance of any deleterious material or elements of weather.
 5. Provide any equipment pads, concrete ductbanks, and concrete bases required for equipment or piping installed as part of this contract.
 6. Complete plumbing connections that are outlined as such in Section 11 4000 and coordinate with the Food Service Contractor
 7. General Contractor to provide and install all site storm sewer, foundation drains, and downspout leader extensions to storm sewer system. Hand-off of storm lines leaving the building is approximately 5 feet from the building, as shown on the drawings.
 8. Plumbing Contractor to provide and install all site gas, water, and sanitary sewer – including trenching/backfilling/site restoration. Plumbing Contractor is to coordinate with the public utilities on all requirements.
 9. Cutting of roof penetrations for MEP work on the roof shall be the responsibility of respective MEP Primes. The General Contractor will flash all penetrations and curbs in new work. GC shall coordinate with the structural steel subcontractor exact requirements for the structural support of all roof-mounted plumbing equipment or openings as applicable. MEP Prime furnishes and lays out roof curbs for their work.
 10. Motor starters for HVAC, Plumbing, and Fire Protection Equipment shall be provided by these respective Contractors for their equipment. Disconnects for the equipment shall be provided by the Electrical Prime Contractor, unless specified otherwise.
 11. General Contractor to provide and install access panels indicated on drawings, unless otherwise noted on drawings. Provide any additional access panels required by Code and for access to your Work. Coordinate with GC on installation to not impact the schedule.
 12. Provide all demolition of existing equipment. This shall include total coordination and installation of all temporary valves, piping, controls, and all other measures to both disable and maintain services to all occupied student, staff, and administration areas in accordance with the phasing plan and the phased design. This shall include the early release and installation on all associated equipment and the relocation of equipment to install and maintain services on a continual basis in accordance with the phasing plan. See phasing plan.
 13. The PC is responsible to perform all of their own flow test for existing onsite water pressures and flows in advance of submitting the design drawings for both plumbing and

fire protection systems and the hydrostatic flow calculations for the fire protection system. The design submittals for the fire protection system shall be prepared and submitted by a professional engineer licensed to provide professional services in the Commonwealth of Pennsylvania.

14. The PC and/or their fire protection contractor shall be responsible to furnish, install, including all temporary piping (distribution and mains), as well as testing and jurisdictional inspections to provide fire protection coverage to all occupied areas in accordance with the phasing plans. This shall include the removal of all temporary piping and installations to provide a continual coverage for occupancy approval as approved by the local Fire Marshall.
 15. PC to provide work supporting modernization of existing hydraulic elevator sprinkler system as noted in Architectural and Plumbing drawings.
- B. Temporary facilities and controls in the Plumbing Contract include, but are not limited to, the following:
1. Piped sewerage and drainage.
 2. Piped gas service.
 3. Piped water service.
 4. Plumbing connections to existing systems and temporary facilities and controls furnished by the General Construction Contract, Plumbing Contract, HVAC Contract, Electrical Contract, and Roofing Contract.
- C. Refer to following specification Sections applicable to this Contract:
1. All Division 01 Sections.
 2. Division 02 Sections.
 3. Division 03 Section.
 - a. 033000 - Cast-in-Place Concrete.
 4. All Division 07 Sections.
 - a. 078413 - Penetration Firestopping.
 - b. 079200 - Joint Sealants.
 5. Division 08 Sections.
 - a. 083113 - Access Doors and Frames.
 6. All Division 20 Sections.
 7. All Division 21 Sections.
 8. Division 31 Sections.
- D. Various Drawings are associated with the Work of this Contract. Each Contractor is obligated to view entire project Drawing Set to ascertain Work of this Contract.

1.8 HVAC CONTRACT

- A. Work in the HVAC Contract includes, but is not limited to, the following:
1. Provide sealants and firestopping as required to the work.
 2. Where necessary to disturb the underslab material, return same to condition acceptable to the General Contractor.

3. Perform all excavation, dewatering, backfill, and compaction testing to install work under this contract.
 4. Protect open ends of installed work by means suitable to prevent entrance of any deleterious material or elements of weather.
 5. Provide any equipment pads, concrete ductbanks, and concrete bases required for equipment or piping installed as part of this contract.
 6. Provide all demolition of the existing HVAC equipment. This shall include the total coordination and installation of all temporary valves, piping, controls, and all other HVAC measures to both disable and maintain services to all occupied student, staff, and administration areas in accordance with the phasing plan and the phased HVAC design.
 - a. This shall include the early release and installation of all boiler and air flow equipment and the relocation of the mechanical equipment to install and maintain services on a continual basis in accordance with the phasing plan.
 7. Provide all refrigerant recovery in accordance with Section 02 4119 and 01 7823.
 8. Complete HVAC connections that are outlined as such in Section 11 4000 and coordinate with the Food Service Contractor.
 9. Install MEP equipment curbs. Curbs shall be provided and laid out by respective Prime Contractor. Roofing Prime Contractor to roof and flash.
 10. Cutting of roof penetrations for MEP work on the roof shall be the responsibility of respective MEP Primes. The General Contractor will flash all penetrations and curbs in new work. GC shall coordinate with the structural steel subcontractor exact requirements for the structural support of all roof-mounted plumbing equipment or openings as applicable. MEP Prime furnishes and lays out roof curbs for their work.
 11. Motor starters for HVAC, Plumbing, and Fire Protection Equipment shall be provided by these respective contractors for their equipment. Disconnects for the equipment, as applicable, shall be provided by the Electrical Contractor, unless specified otherwise.
 12. General Contractor to provide and install access panels indicated on drawings, unless otherwise noted on drawings. Provide any additional access panels required by Code and for access to your Work. Coordinate with GC on installation to not impact the schedule.
 13. The HVAC Contractor shall be considered the MEP Coordinator and shall be responsible for the coordination of all MEP/FP shop drawings prior to the start of the rough-in work. This shall include the leadership of onsite, and electronic, coordination meetings that will provide the other mechanical contractors with guidance on how to install their pathways for overall coordination for all trades as well as the designed ceiling heights. The HVAC Contractor is responsible to maintain and validate unified field-markups of all changes to the Contract documents.
- B. Temporary facilities and controls in the HVAC Contract include, but are not limited to, the following:
1. Heating, Cooling, and Ventilation.
- C. Refer to following specification Sections applicable to this Contract:
1. All Division 01 Sections.
 2. Division 02 Sections.
 3. Division 03 Section.
 - a. 033000 - Cast-in-Place Concrete.
 4. Division 07 Sections.
 - a. 078413 - Penetration Firestopping.
 - b. 079200 - Joint Sealants.

5. Division 08 Sections.
 - a. 083113 - Access Doors and Frames.
 6. All Division 23 Sections.
 7. Division 31 Sections.
- D. Various Drawings are associated with the Work of this Contract. Each Contractor is obligated to view entire project Drawing Set to ascertain Work of this Contract.

1.9 ELECTRICAL CONTRACT

- A. Work in the Electrical Contract includes, but is not limited to, the following:
1. Provide sealants and firestopping as required relating to this work.
 2. Disconnect existing emergency generator, uninstall ATS and main disconnect. Relocated to designated on-site storage location. Owner shall arrange removal from site.
 3. Perform all excavation, dewatering, backfill, and compaction testing to install work under this contract.
 4. Protect open ends of installed work by means suitable to prevent entrance of any deleterious material or elements of weather.
 5. Provide any equipment pads, concrete ductbanks, and concrete bases required for equipment or piping installed as part of this contract.
 6. Furnish and install all wood backboards and in-wall blocking required for the Electrical Contract work.
 7. Complete electrical connections that are outlined as such in Section 11 4000 and coordinate with the Food Service Contractor.
 8. All electrical site utility work, including all ductbanks, conduits, concrete encasements, site lighting, fiber-optic, data, phone, and cable and associated excavation/backfill are by the Electrical Contractor, as shown on the construction documents.
 9. Motor starters for HVAC, Plumbing, and Fire Protection Equipment shall be provided by these respective contractors for their equipment. Disconnects for the equipment shall be provided by the Electrical Contractor, unless specified otherwise.
 10. Electrical Contractor shall provide temporary and permanent feeders and connections to electrical systems as necessary to make the new, renovated, and existing areas available for their intended use. These systems shall include power, lighting, fire alarm, public address, sound, data, telephone, security, and CCT systems, etc. Existing systems must remain operational.
 11. General Contractor to provide and install access panels indicated on drawings, unless otherwise noted on drawings. Provide any additional access panels required by Code and for access to your Work. Coordinate with GC on installation to not impact the schedule.
 12. Provide all demolition of the existing electrical equipment. ~~This shall include the total coordination and installation of all temporary circuits, lighting, fire alarm, controls, and all other electrical measures to both disable and maintain services to all occupied student, staff, and administration areas in accordance with the phasing plan and the phased electrical design.~~
 13. Provide, install, and remove any and all temporary site and building electrical and lighting requirements to meet OSHA standards and as indicated in the contract documents.
 14. Furnish and install all conduit runs, cable tray, and/or J-hooks for the use by the Owner's contractors and as shown on the contract documents.
 15. EC to provide work supporting modernization of existing hydraulic elevator electrical, fire alarm and communication systems as noted in Architectural and Electric drawings.

- B. Temporary facilities and controls in the Electrical Contract include, but are not limited to, the following:
1. Electric power service and distribution.
 2. Lighting, including site lighting.
 3. Electrical connections to existing systems and temporary facilities and controls furnished by the General Construction Contract, Plumbing Contract, HVAC Contract, Electrical Contract, and Roofing Construction Contract.
- C. Refer to following specification Sections applicable to this Contract:
1. All Division 01 Sections.
 2. Division 02 Sections.
 3. Division 03 Section.
 - a. 033000 - Cast-in-Place Concrete.
 4. Division 07 Sections.
 - a. 078413 - Penetration Firestopping.
 - b. 079200 - Joint Sealants.
 5. Division 08 Sections.
 - a. 083113 - Access Doors and Frames.
 6. All Division 26 Sections.
 7. All Division 27 Sections.
 8. All Division 28 Sections.
 9. Division 31 Sections.
- D. Various Drawings are associated with the Work of this Contract. Each Contractor is obligated to view entire project Drawing Set to ascertain Work of this Contract.

1.10 WORK BY OWNER

- A. Owner will award contracts scheduled to commence on various dates during this Construction. Work under these will include:
1. Items noted 'NIC' (Not in Contract): Will be furnished and installed by Owner in accordance with the project schedule.
 2. Owner will remove and retain possession of the following items prior to start of work:
 - a. All Owner items will be removed prior to the Pre-Bid Meeting.
 3. See 011000 "Summary of Work" for additional Owner-performed Work.

1.11 PRIME CONTRACTOR USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow:
1. Work by Others and Work by Owner.
 2. Use of project site is unlimited.
- B. Coordinate use of premises with the Architect and the Owner. Lead Prime Contractor will coordinate and approve location and quantity of storage trailers and lay down schedules.

- C. Each Prime Contractors shall assume full responsibility for the protection and safekeeping of products stored on the site under his contract. Prime Contractors shall not be permitted to store materials inside the building structure. As Work progresses, the Lead Prime Contractor will review storage of materials in the new addition.
- D. Each Prime Contractor shall immediately move stored products, under his control, interfering with operations of Owner or another separate Contractor. If Contractor fails to immediately move stored materials, interfering with operations of the Owner and other separate Contractors, the Owner will have the materials moved by another separate Contractor and charge the responsible Contractor the moving charger. Damages incurred are the responsibility of the Prime Contractor whose material was moved.
- E. Each Prime Contractor shall obtain and pay for additional storage or work areas needed for operations.
- F. Contractor Parking: Contractor parking shall be limited to the areas within the construction fencing. No parking outside of the site shall be permitted. General Construction Contractor to provide stone or hard surface area within fence for contractor parking if necessary.
- G. Access to Site: Limited to that indicated on the Contract Drawings for construction. Keep driveways and entrances serving the premises clear and available to the Owner, Architect, Emergency Personnel and Owner's employees at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- H. Maintain emergency building exits during construction as required by local fire codes, and as necessary to provide for the safety of construction workers and building occupants. This shall be the responsibility of the General Construction Prime Contractor.
- I. Work Hours:
 - 1. Time Restrictions for Performing Exterior Work: Perform no exterior work interfering with pedestrian or vehicular traffic during hours of 7:00 AM to 5:00 PM. Coordinate exceptions with Owner. Comply with local governing authorities for time restrictions for performing exterior work.
 - 2. Established work hours will be between 7:00 AM and 5:00 PM. If a Contractor feels overtime hours are necessary to meet the contractual schedule commitment of the Contractor, Contractor shall work such overtime hours, additional shifts, weekends, and holidays. Costs resulting from working these times shall be borne by the said Contractor. Cost may include standby costs necessary to provide temporary power and lighting.
 - 3. Notice of Work outside of established work hours shall be provided at least 24 hours prior to commencement.
 - 4. Work shall comply with all local Noise Ordinances.
- J. Utility Outages and Shutdown:
 - 1. Plan Work to minimize shutdown time of services. Work that substantially affects the work of the Owner and other Contractors shall be referred to a shutdown. This includes, but is not limited to, electrical service transfers, sterilization of domestic water, water service transfers, start-up of some equipment, etc. Contractors are required to give required notices to the proper authorities related to the work in their charge. To the maximum extent practicable, shutdowns shall be scheduled for periods when least need for that utility is anticipated. Provide within the Contract Sum an amount sufficient to cover all required overtime in connection with utility shutdown, all in accordance with the designated phasing plans. This will include multiple utility shutdowns.

2. Contractor is responsible to do due diligence to determine what systems are affected by the shutdown and identify these systems on the request form. Failure to receive proper approval will result in denial of the shutdown request.
 3. Contractors are required to strictly comply with governing laws, rules, regulations, and inspection requirements, both as to labor and materials, and pay fees in connection therewith, and shall bear loss from neglect.
- K. Jobsite Conduct: Each Contractor's management should review with their employees that it is imperative that their conduct be socially acceptable at all times. Vulgar or abusive language, sexually suggestive comments or gestures are strictly prohibited and will result in removal from the jobsite and criminal prosecution. At Owner's, Architect's or Lead Prime Contractor's discretion, workers not obeying the Jobsite Rules of Conduct or Safety Rules can be removed from the project, without prior warning, and not permitted to return, regardless of the respective Contractor's disciplinary policies.

1.12 OWNER OCCUPANCY

- A. Owner will not occupy the building and site during entire period of construction until Occupancy approval has been granted.
- B. Each Prime Contractor shall, at all times, conduct their operations ensuring least inconvenience to general public.
- C. Owner shall have the right to make use of any completed or partially completed portion of the work whether or not the time may have expired for completion by such use shall be deemed an acceptance of the work so taken or used, or any portion thereof. Prior to Owner taking possession, an inspection shall be made by the Architect, and Owner of the portions to be occupied to determine if same is in conformity with the contract and the Contractor will not be liable for any subsequent damage or operating charges due to occupancy of the completed portion, unless specified otherwise herein.
- D. Each Prime Contractor shall secure and supply the Owner with an endorsement from the insurance carrier and surety permitting occupancy of the building or use of the project during the remaining period of construction.
- E. Each Prime Contractor shall secure and pay costs required for necessary permits, licenses, approvals, or certificates required for occupancy or completion of construction as issued or required by any agency having jurisdiction thereof.
- F. Owner will execute Certificate of Substantial Completion for the entire project:
 1. After Owner occupancy, Contractor shall allow
 - a. Access for Owner's personnel
 - b. Access for Public
 2. Upon occupancy, Owner will be responsible for:
 - a. Operation of Plumbing, Fire Protection, HVAC, and Electrical Systems

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements governing allowances.
 - 2. Identification and description of allowances for each contract.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
- C. Related Requirements:
 - 1. Section 012200 "Unit Prices" for procedures for using unit prices.
 - 2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.2 SELECTION AND PURCHASE

- A. At earliest practical date after Contract award, advise Architect of date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from designated supplier.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit quantity surveys to show actual quantities of material removed from the site or Project.
- C. 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.

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

1.5 COORDINATION

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

1.6 LUMP-SUM, UNIT-COST, AND QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's off-site or on-site storage location as directed.
- D. At Project closeout, credit unused amounts remaining in lump-sum contingency allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Proposed Change Order (PCO) based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. Submit PCO to Architect. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit explanation and substantiating documentation of change in scope of work.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
 - 5. Once quantities of materials have been agreed to, Architect will process a Change Order (CO) for additional work.

- B. Submit requests for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 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 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 FOR GENERAL CONTRACTOR

- A. Allowance G-01: Quantity Allowance: Include 200 square feet of concrete sidewalk replacement – to include complete demolition of existing sidewalk, removal of spoils, subgrade preparation, stone base, welded wire reinforcing mats, and the placement and final finishing of the concrete material in depths, mix design, and strengths that are consistent with the base concrete specifications.
- B. Allowance G-02: Quantity Allowance: Provide 300 square feet of additional cement-based underlayment, up to an entire room if needed, only for those floor areas identified by the Design Professional as an unforeseen condition and in need of additional substrate preparation, in excess of that already specified in the drawings, prior to installation of the finish flooring products. No additional compensation will be made for any substrate floor areas that were damaged because of the Contractor's improper demolition and original floor covering removal methods. The Contractor is responsible to keep records of their own quantities of underlayment and then reconcile them with those of the Design Professional prior to submitting a Contractor Change Request.
- C. Coordinate quantity allowance adjustments with unit-price requirements in Section 012200 "Unit Prices."

END OF SECTION

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements for unit prices.
 - 2. Identification and description of unit prices for each contract.
- B. Related Documents:
 - 1. Document 004113 "Bid Form" for submission of Unit Price costs associated with each Prime Contract.
- C. Related Sections:
 - 1. Section 012600 "Contract Modification Procedures" for procedures regarding submitting and handling of Change Orders.
 - 2. Section 012900 "Payment Procedures" for measurement and payment of unit price items.
 - 3. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.2 DEFINITIONS

- A. Unit Price: An amount proposed by bidders, stated on the bid Form, as a price per unit of measure for materials, equipment, or services, or a portion of the Work ADDED TO or DEDUCTED FROM the Contract Sum by appropriate modification, if Work scope or estimated quantities of Work required by Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices shall be a comprehensive cost including all necessary material, plus delivery costs, installation, insurance, applicable taxes, overhead, and profit.
- B. Unit prices will be exercised if certain conditions are discovered or required during the Work, and if certain options are revised by the Owner.
- C. Coordinate related systems and modify surrounding materials as required to complete the Work, including changes under each unit price.
- D. Complete Unit Price listing shown on appropriate Form of Bid.
- E. 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.
- F. Owner reserves the right to take following actions regarding unit prices:
 - 1. Accept any or all unit prices that Owner considers fair and reasonable.

2. Negotiate with acceptable low bidder to amount acceptable to both Owner and Contractor.
 3. Reject Contractor's measurement of work that involves use of established unit prices and to have work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- G. It is specifically understood that unit prices, when accepted, are intended to cover quantities less than 10 percent in excess of Base Bid quantities. When unit price quantities exceed 10 percent, negotiated change order procedures will be enacted to cover that work.
- H. List of Unit Prices: A list of unit prices for each Prime Contract is included in PART 3 of this Section. 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 LIST OF UNIT PRICES - GENERAL CONSTRUCTION WORK

- A. Unit Price UG-01: Brick Masonry Repair/Repointing **without** Lift Equipment.
1. Description: For the repair of damaged or deteriorated existing brick masonry that does not require use of a lift or extensive scaffolding; approximately twelve feet or less above grade.
 2. Unit of Measurement: Square foot.
 3. Specification: Refer to Sections 040120.63 "Brick Masonry Repair" and 040120.64 "Brick Masonry Repointing."
- B. Unit Price UG-02: Brick Masonry Repair/Repointing **with** Lift Equipment.
1. Description: For the repair of damaged or deteriorated existing brick masonry that requires the use of a lift or extensive scaffolding; above approximately twelve feet or more above grade.
 2. Unit of Measurement: Square foot.
 3. Specification: Refer to Sections 040120.63 "Brick Masonry Repair" and 040120.64 "Brick Masonry Repointing."
- D. Unit Price UG-03: Cutting and Patching of Existing Concrete Floor Slab.
1. Description: Cutting of new or existing concrete floor slabs up to 6 inches thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete in accordance with Division 01 Section "Cutting and Patching" not otherwise indicated in the Contract Documents.
 2. Unit of Measurement: Per Square foot of concrete removed.
 3. Specification: Refer to Sections 0300130 "Maintenance of Cast-In-Place Concrete" and 033000 "Cast-In-Place Concrete."

G. Unit Price UG-04: Floor Leveler.

1. Description: Provide additional cement-based underlayment, up to an entire room if needed, only for those floor areas identified by the Design Professional as an unforeseen condition and in need of additional substrate preparation, in excess of that already specified in the drawings, prior to installation of the finish flooring products. No additional compensation will be made for any substrate floor areas that were damaged because of the Contractor's improper demolition and original floor covering removal methods. The Contractor is responsible to keep records of their own quantities of underlayment and then reconcile them with those of the Design Professional prior to submitting a Contractor Change Request.
2. Unit of Measurement: Square foot.
3. Specification: Refer to Section 035413 "Gypsum Cement Underlayment."

H. Unit Price UG-05: Interior Panel Exit-Egress Signage.

1. Description: Provide and install an additional panel sign of Type 'A' or its variants at the requested location and required height to meet egress Code requirements.
2. Unit of Measurement: Each.
3. Specification: Refer to Section 101423.16 "Room-Identification Panel Signage."

K. Unit Price UG-06: Asphalt Replacement.

1. Description: Provide replacement of existing asphalt areas as directed by the Owner or Architect, and not those already indicated on the base bid documents. Proposed unit price cost shall include all necessary excavation, removal of spoils, geotech fabric, stone base, and asphalt base and wearing courses to the proper pavement profile, as shown in the contract documents for similar work.
2. Unit of Measurement: Square yard.
3. Specification: Refer to Section 321200 "Flexible Paving."

L. Unit Price UG-07: Concrete Sidewalk Replacement.

1. Description: Remove and replace existing sidewalk areas at the direction of the Owner or Architect. The work shall include the complete demolition, removal of spoils, subgrade preparation, stone base, welded wire reinforcing mats, and the placement and final finishing of the concrete material in depths, mix design, and strengths that are consistent with the base concrete specifications.
2. Unit of Measurement: Square foot.
3. Specification: Refer to Section 033000 "Cast In Place Concrete."

M. Unit Price UG-08: Concrete Curb Replacement.

1. Description: Remove and replace existing concrete curb areas at the direction of the Owner or Architect. The work shall include the complete demolition, removal and disposal of spoils, subgrade preparation, stone base, reinforcing, and the placement and final finishing of the concrete material in depths, mix design, and strengths that are consistent with the base concrete specifications.
2. Unit of Measurement: Lineal foot.
3. Specification: Refer to Section 033000 "Cast In Place Concrete."

3.2 LIST OF UNIT PRICES - HVAC WORK

A. Unit Price UH-1: Ductwork

1. Description: Furnish and install additional insulated ductwork including all required supports, hangers and insulation. Maximum size is 24x12.
2. Unit of Measurement: Pound.
3. Specification: Refer to section 233113 "Metal Ducts" and section 230700 "HVAC Insulation."

B. Unit Price UH-2: Access Doors

1. Description: Furnish and install additional insulated ductwork including all required supports, hangers and insulation. Unit size basis: 12" x 12".
2. Unit of Measurement: Each.
3. Specification: Refer to Section 083113 "Access Doors and Frames" and Section 233300 "Air Duct Accessories."

3.3 LIST OF UNIT PRICES - ELECTRICAL WORK

A. Unit Price UE-1: Duplex Receptacle.

1. Description: Provide and install an additional duplex receptacle to include backbox and faceplate.
2. Unit of Measurement: Each.
3. Specification: Refer to Section 262726 "Wiring Devices".

B. Unit Price UE-2: Data Receptacle.

1. Description: Provide and install an additional Category 6 data jack – to include backbox, faceplate, and 200 feet cable length – according to base data receptacle specification.
2. Unit of Measurement: Each.
3. Specification: Refer to Section 270528 "Pathways for Communication Systems."

C. Unit Price UE-3: Illuminated Exit Sign & Wiring.

1. Description: Provide and install an additional illuminated exit sign assembly – to include appropriate mounting equipment, 3/4 inch conduit/raceway with #12 conductors and #12 ground wire, all necessary wall penetration cutting and patching, terminations, and connections – according to base specification for similar work. Maximum distance is 35 feet. Connections to be made to closest emergency exit sign circuit.
2. Unit of Measurement: Each.
3. Specification: Refer to Section 265100 "Interior Lighting."

D. Unit Price UE-4: Fire Alarm Audible/Visual Device & Wiring.

1. Description: Provide and install an additional fire alarm A/V device assembly – to include A/V device, backbox, cabling, conduit, necessary wall penetration cutting and patching, terminations, connections to fire alarm system, programming, and additional power supplies required – according to base fire alarm specification for similar work. Maximum distance is 50 feet.

2. Unit of Measurement: Each.
 3. Specification: Refer to Section 284621.11 "Addressable Fire-Alarm Systems".
- E. Unit Price UE-5: 20A Wiring in Conduit.
1. Description: Provide and install wiring for additional 20A devices; 2#12 & 1#12G in 3/4" CND.
 2. Unit of Measurement: Lineal foot.
 3. Specification: Refer to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Unit Price UE-6: 20A Wiring in MC.
1. Description: Provide and install wiring for additional 20A devices; 2#12 & 1#12G in MC.
 2. Unit of Measurement: Lineal foot.
 3. Specification: Refer to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 LIST OF UNIT PRICES – PLUMBING AND FIRE PROTECTION WORK

- A. Unit Price UP-1: Ball Valve (1/2 inch dia.)
1. Description: Furnish and install 1/2 inch ball valve within plumbing line – to include all required accessories and tagging to align with similar work in base scope.
 2. Unit of Measurement: Each.
 3. Specification: Refer to Section 220523.12 "General Duty Valves for Plumbing Piping."
- B. Unit Price UP-2: Ball Valve (3/4 inch dia.)
1. Description: Furnish and install 3/4 inch ball valve within plumbing line – to include all required accessories and tagging to align with similar work in base scope.
 2. Unit of Measurement: Each.
 3. Specification: Refer to Section 220523.12 "General Duty Valves for Plumbing Piping."
- C. Unit Price UP-3: Ball Valve (1 inch dia.)
1. Description: Furnish and install 1 inch ball valve within plumbing line – to include all required accessories and tagging to align with similar work in base scope.
 2. Unit of Measurement: Each.
 3. Specification: Refer to Section 220523.12 "General Duty Valves for Plumbing Piping."
- D. Unit Price UP-4: Copper Piping (1/2 inch dia.)
1. Description: Furnish and install 1/2 inch copper piping – to include support hangers, insulation, labels, and tagging to align with similar work in base scope. Include (2) 90-degree elbows and all soldered joints.

2. Unit of Measurement: Lineal foot.
 3. Specification: Refer to section 221116 "Domestic Water Piping", Section 220529 "Hangers and Supports for Plumbing Piping and Equipment", and Section 220719 "Plumbing Piping Insulation."
- E. Unit Price UP-5: Copper Piping (3/4 inch dia.)
1. Description: Description: Furnish and install 3/4 inch copper piping – to include support hangers, insulation, labels, and tagging to align with similar work in base scope. Include (2) 90-degree elbows and all soldered joints.
 2. Unit of Measurement: Lineal foot.
 3. Specification: Refer to section 221116 "Domestic Water Piping", Section 220529 "Hangers and Supports for Plumbing Piping and Equipment", and Section 220719 "Plumbing Piping Insulation."
- F. Unit Price UP-6: Copper Piping (1 inch dia.)
1. Description: Description: Furnish and install 1 inch copper piping – to include support hangers, insulation, labels, and tagging to align with similar work in base scope. Include (2) 90-degree elbows and all soldered joints.
 2. Unit of Measurement: Lineal foot.
 3. Specification: Refer to section 221116 "Domestic Water Piping", Section 220529 "Hangers and Supports for Plumbing Piping and Equipment", and Section 220719 "Plumbing Piping Insulation."
- G. Unit Price UP-7: Concealed Pendant Sprinkler Head Assembly
1. Description: Furnish and install concealed pendant sprinkler head assembly – to include cover plate, flexible hose fitting and all required accessories and tagging to align with similar work in base scope.
 2. Unit of Measurement: Each.
 3. Specification: Refer to Section 211313 "Wet-Pipe Sprinkler System."

END OF SECTION

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements of project Alternates.
 - 2. Identification and description of project Alternates for each Contract.
- B. Related Documents:
 - 1. Document 004113 "Bid Form" for submission of Alternates associated with this Prime Contract.
- C. Related Sections:
 - 1. Section 012600 "Contract Modification Procedures" for procedures regarding submitting and handling of Change Orders.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in bidding requirements that may be ADDED TO or DEDUCTED FROM base bid amount if Owner decides to accept a corresponding Alternate either in amount of construction to be completed or in products, materials, equipment, systems, or installation methods described in Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. Cost or credit for each Alternate is net addition to or deduction from Contract Sum to incorporate alternate into the Work. No other adjustments are made to Contract Sum.

1.3 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. Alternates will be exercised and accepted at the option of Owner. Accepted Alternates shall be identified and included in the Agreement. No other Alternates are being considered for other contracts associated with this project.
- C. Coordinate related systems and modify surrounding materials as required to incorporate accepted Alternate into the Work.
- D. Notification: Immediately following award of the Contract, notify each party involved, in writing, of status of each alternate. Indicate if Alternates have been accepted or rejected.
- E. Execute accepted Alternates under same conditions as other work of Contract.
- F. Alternate prices shall be a comprehensive cost including all necessary material, delivery costs, installation, insurance, applicable taxes, overhead, and profit.
- H. Complete Alternates shown on appropriate Form of Bid.

- I. See individual Specification Sections for work that requires establishment of Alternate work scopes.
- J. Alternates: A list of Alternates for each Prime Contract is included in PART 3 of this Section. Specification Sections referenced in the schedule contain requirements for materials described under each Alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ALTERNATES FOR GENERAL CONSTRUCTION WORK

- A. Alternate G-01: Replace Horizontal Siding and Dormer Windows.
 - 1. Base Bid Description: Existing siding and windows to remain.
 - 2. Alternate Description:
 - a. Replace existing horizontal siding, weather barrier (if present) and associated trim at existing gable areas, chimneys and roof dormers with new weather barrier, composite siding and associated trim.
 - b. Replace existing fixed glazing window units (4) in roof dormer areas including trim.
 - c. Paint remaining trim adjacent to windows and siding including soffits and fasciae; color tbd by Owner.
 - 3. Identify this Alternate as an ADD TO the base bid proposal by inserting proposed cost on appropriate line of Bid Form.
- B. Alternate E-01: Deduct purchase of Emergency Generator
 - 1. Base Bid Description: Provide new Emergency Generator as specified in Contract Documents.
 - 2. Alternate Description: Electrical Contractor to provide a deduct price for the purchase and site delivery of the generator, automatic transfer switch (ATS) and main disconnect. EC shall remain responsible for coordination and installation of concrete pad, transportation of generator from delivery location on site to final location, installation of generator and associated materials and all subsequent activities related to generator startup and testing as if it was purchased through the EC contract. EC shall coordinate electric system compatibility with Generator.
 - a. EC shall not be responsible for warranty claims related to material or equipment failure not attributable to its installation and startup work.
 - 3. Owner may provide notice of Alternate E-01 election within forty-five (45) days of issuance of Notice to Proceed. Contract values shall be adjusted accordingly.
 - 4. Identify this Alternate as a DEDUCT FROM the base bid proposal by inserting proposed cost on appropriate line of Bid Form.

END OF SECTION

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Document 007200 "General Conditions" for requirements related to substitutions.
2. Section 012100 "Allowances" for products selected under an allowance.
3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor, not by subcontractors or manufacturer's representatives.

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 that are not a direct result of a product no longer being commercially available.

1.3 ACTION SUBMITTALS

A. Substitution Requests During Bidding: Submit a digital copy of each request for consideration at least ten (10) calendar days prior to bid date. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A or form acceptable to Architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified products 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 and other test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports or test reports evidencing compliance with building code in effect for Project, from model code organization acceptable to Authorities having Jurisdiction.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including manufacturer's anticipated lead time after order is placed and 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 as of receipt of quote request, a lack of availability or other delays in delivery was anticipated.
 - 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.
 - n. Contractor's waiver of rights to additional payment or time for any direct or consequential damages resulting from acceptance of substitution.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 2 days of receipt of a request for substitution. Architect will include accepted substitutions as part of a bidding Addendum.
4. Where applicable for assessment of proposed products physical or aesthetic qualities, submit two physical samples for Architect's assessment. Where Architect may make a selection from manufacturer's available colors, finishes, etc., submit two full sets of physical samples from which the Architect may select a substitution product.
- B. Substitution Requests After Bidding: When permitted by requirement of this Paragraph.
- 1. Substitution requests after bidding will only be considered when one of following conditions apply:
 - a. Specified product is no longer commercially available.
 - 2. Contractor's Action: Submit a digital copy of each request for consideration to Architect through Construction Manager. Identify product, fabrication, or installation method to be substituted. Include Specification Section number and title and Drawing numbers and titles. Include documentation identified in various subparagraphs in Paragraph A of this Article as are applicable.
 - 3. 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 through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.

- b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.
- c. Where applicable for assessment of proposed products physical or aesthetic qualities, submit two physical samples for Architect's assessment. Where Architect may make a selection from manufacturer's available colors, finishes, etc., submit two full sets of physical samples from which the Architect may select a substitution product.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of 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 30 days prior to date required for submission of related submittals.
 - 1. Conditions: If following conditions are not satisfied, Architect will return requests as not approved, except to record noncompliance with these requirements. Architect will consider Contractor's request for substitution if requested substitution:
 - a. Is consistent with Contract Documents and will produce indicated results.
 - b. Offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - c. Is fully documented and properly submitted.
 - d. Will not adversely affect Contractor's construction schedule.
 - e. Will not delay Substantial Completion.
 - f. Has received necessary approvals of authorities having jurisdiction.
 - g. Is compatible with other portions of the Work.
 - h. Has been coordinated with other portions of the Work.
 - i. Provides specified warranty.
 - j. When involving more than one Contractor, has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other materials and products, and is acceptable to all Contractors involved
- B. Substitutions for Convenience by Contractor: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION

CSI Form 13.1A

SUBSTITUTION REQUEST FOR CAUSE

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____
Installer: _____ Address: _____ Phone: _____
History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST FOR CAUSE

(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- 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 are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: ☐

A/E's REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- ☐ Substitution rejected - Use specified materials.
- ☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E
☐ Other:

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.2 MINOR CHANGES IN THE WORK

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

1.3 CHANGE ORDER REQUESTS

- A. Owner-Initiated Change Order Requests (COR): Architect will issue a detailed description of proposed changes in the Work that may require adjustment to Contract Sum and/or Contract Time. If necessary, description will include supplemental or revised Drawings and Specifications.
 - 1. COR's are for informational purposes only and are not instructions either to stop work in progress or to execute proposed change.
 - 2. Within time specified in COR, or within 10 days when not otherwise specified, submit via email a Proposed Change Order (PCO) estimating cost adjustments to Contract Sum and/or 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 quantity (hours) and costs of labor and supervision directly attributable to the change.
 - d. Whether or not an adjustment to Contract Time is requested; include a revised Construction Schedule that indicates the effect of the change, including, but not limited to, additional activities, deleted activities, changes in activity durations, changes to activity relationships, the resulting changes in the start and finish dates for all activities, and the impact on the critical path.
 - e. Perform a Time Impact Analysis to demonstrate that the adjustment to Contract Time is the net due to Contractor, and takes into account any contribution Contractor, or other Contractors may have had.

- 1) Additional Contract Time will be approved only if either the critical path is extended and the date of Substantial Completion is delayed, or a new critical path replaces the previous critical path and the date of Substantial Completion is delayed.
 - 2) Use available float before requesting an extension of the Contract Time.
 3. Upon receipt of Contractor's PCO, PCO backup, and if applicable revised schedule, Architect will review PCO. Architect may request a meeting with Contractor to review PCO and revised schedule, and to negotiate scope of work and adjustment to Contract Sum and/or Contract Time for the work.
 4. Architect will then recommend to Owner whether or not PCO should be accepted by Owner.
 - a. If PCO is accepted, Owner will formally approve PCO and Architect will issue a Change Order (CO) for signature. If additional Contract Time is required, no-cost Extensions of Time will be issued to impacted Contractors.
 - b. If PCO is not accepted, COR will be withdrawn. Contractor will make no changes to its work.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to Contract, Contractor may initiate a request for an adjustment to Contract Sum and/or Contract Time by submitting a PCO via established communication protocols to the Architect.
 1. Include a statement outlining all conditions causing Contractor to experience an increase in cost, why such conditions constitute a change to the Work or a change to contract conditions and are not attributable to Contractor, and a description of the effort required by Contractor to overcome such conditions.
 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 quantity (hours) and costs of labor and supervision directly attributable to the change.
 5. If Contractor requests an adjustment to Contract Time, include a revised Construction Schedule that indicates the effect of the change, including, but not limited to, additional activities, deleted activities, changes in activity durations, changes to activity relationships, resulting changes in start and finish dates for all activities, and impact on critical path.
 6. Perform a Time Impact Analysis to demonstrate that adjustment to Contract Time is the net due to Contractor, and takes into account any contribution Contractor, or other Contractors, may have had.
 - a. Additional Contract Time will be approved only if either critical path is extended and date of Substantial Completion is delayed, or a new critical path replaces previous critical path and date of Substantial Completion is delayed.
 - b. Use available float before requesting an extension of Contract Time.
 7. Comply with requirements in Section 012500 "Substitution Procedures" if proposed change requires substitution of one product or system for product or system specified.
 8. Upon receipt of Contractor's PCO, PCO backup, and if applicable revised schedule, Construction Manager and Architect will review PCO. Construction Manager may request a meeting with Contractor to review PCO and revised schedule, and to negotiate the adjustment to Contract Sum and/or Contract Time.

9. Construction Manager and Architect then will recommend to Owner whether or not PCO should be accepted by Owner.
 - a. If PCO is accepted, Owner will formally approve PCO and Construction Manager will issue a Prime Contract Change Order (PCCO) for signature. If additional Contract Time is required, no-cost Extensions of Time will be issued to impacted Contractors.
 - b. If PCO is not accepted, PCO will be rejected and Contractor notified that it has been rejected.
 - C. Contractor-Initiated Extension of Time: If latent or changed conditions require modifications to Contract Time, Contractor may initiate a request for an adjustment to Contract Time by submitting a PCO via established communication protocols to the Architect.
 1. Include a statement outlining all conditions causing Contractor to experience an increase in time required to complete its Work, why such conditions constitute a change to the Work or a change to contract conditions and are not attributable to Contractor, and a description of effort required by Contractor to overcome such conditions.
 2. Include a revised Construction Schedule that indicates effect of the change, including, but not limited to, additional activities, deleted activities, changes in activity durations, changes to activity relationships, resulting changes in start and finish dates for all activities, and impact on critical path.
 - a. Perform a Time Impact Analysis to demonstrate that adjustment to Contract Time is net due to Contractor, and takes into account any contribution Contractor, or other Contractors may have had.
 3. Perform a Time Impact Analysis to demonstrate that adjustment to Contract Time is net due to Contractor, and takes into account any contribution Contractor, or other Contractors may have had.
 - a. Additional Contract Time will be approved only if either critical path is extended and date of Substantial Completion is delayed, or a new critical path replaces previous critical path and date of Substantial Completion is delayed.
 - b. Use available float before requesting an extension of Contract Time.
 4. Upon receipt of Contractor's PCO, PCO backup, and if applicable revised schedule, Construction Manager and Architect will review PCO. Construction Manager may request a meeting with Contractor to review PCO and revised schedule, and to negotiate adjustment to Contract Sum and/or Contract Time.
 5. Construction Manager and Architect then will recommend to Owner whether or not PCO should be accepted by Owner.
 - a. If PCO is accepted, Owner will formally approve PCO and Construction Manager will issue a Change Order (CO) for signature.
 - b. If PCO is not accepted, PCO will be rejected and Contractor notified that it has been rejected.
- 1.4 ADMINISTRATIVE CHANGE ORDERS
- A. Unit Price-Based Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of unit price-based allowances.

1.5 CHANGE ORDER PROCEDURES

- A. Upon Owner's and Architect's approval of a PCO, the Architect will issue a Change Order (CO) for signatures to Contractor and Owner, in that order via established communication protocols.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714 or its proprietary form. A Construction Change Directive instructs Contractor to immediately proceed with a change in the Work, for subsequent negotiation of adjustment to Contract Sum and/or Contract Time, and inclusion in a Contract Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
 - 2. If an adjustment to Contract Time is requested, include a revised Construction Schedule that indicates the effect of change, including, but not limited to, additional activities, deleted activities, changes in activity durations, changes to activity relationships, resulting changes in start and finish dates for all activities, and impact on critical path.
 - a. Perform a Time Impact Analysis to demonstrate that adjustment to Contract Time is net due to Contractor, and takes into account any contribution Contractor, or other Contractors may have had.
 - 3. If an adjustment to Contract Time is requested, perform a Time Impact Analysis to demonstrate that adjustment to Contract Time is net due to Contractor, and takes into account any contribution Contractor, or other Contractors may have had.
 - a. Additional Contract Time will be approved only if either critical path is extended and date of Substantial Completion is delayed, or a new critical path replaces previous critical path and date of Substantial Completion is delayed.
 - b. Use available float before requesting an extension of Contract Time.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 007346 "Wage Rate Determination" for Prevailing Wage Rates to be reflected on all Certified Payroll reports.
 - 2. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 3. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 4. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 5. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

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

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of schedule of values with preparation of Contractor's construction schedule
 - 1. Coordinate line items in 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 no later than 14 days after Contract Execution, and no later than 21 days before the date scheduled for submittal of initial Applications for Payment. Failure to submit Schedule of Values on time will result in the initial Application for Payment not being processed until the next payment period.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the Project name and Owner's Contract number on the schedule of values.
2. Arrange schedule of values consistent with format of, and include all information shown on, AIA Document G703.
3. Provide in Microsoft Excel format.
4. Arrange schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Item number.
 - b. Description of the Work; start Description with Specification Section Number.
 - c. Dollar value, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - d. For each Item number, identify whether it is for labor, material or purchased equipment; do not combine labor, material or purchased equipment in the same Item number.
 - e. Change Order that affect value will be listed as a separate Item number.
5. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
6. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
7. 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.
8. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
9. Where the Project consists of multiple buildings, areas, and or floors, provide separate line items for each instance of a common task by building, area, and floor (example: for wall painting in Areas A, B and C, on floors 1 and 2, provide 6 line items – Painting Area A 1st Fl; Painting Area A 2nd Fl; etc.). If no such breakout is provided, percentage completion related to the entire project shall be left to the discretion of the Architect or Owner.
10. 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.
11. Alternates: Provide a separate line item in the schedule of values for each Alternate(s) awarded as part of the Contract.
12. Bonds and Insurance: Provide a separate line item for Bonds and Insurance, not to exceed 3% of Contract Sum.
13. Closeout Documents: Provide a separate line item for Closeout Documents, in an amount totaling no less than 1% of Contract Sum.
14. Provide a separate line item for each of the following Temporary Utilities and Temporary Facilities and Controls.
 - a. Daily cleaning.
 - b. Dumpsters (delivering, removing and disposing of waste).
 - c. Temporary Sanitary Facilities.
 - d. Construction Fence

- e. Construction Manager's Field Office.
 - f. Temporary Water.
 - g. Temporary Heating, Ventilating, Cooling, and Dehumidification.
 - h. Temporary Electricity and Lighting.
15. Schedule Approval: Schedule of Values shall be approved by Architect prior to Contractor submitting its first Application for Payment.
16. Schedule Updating: Update and resubmit the schedule of values before the next Application for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

- A. Initial Application for Payment will not be approved until all conditions precedent identified in these Contract Documents have been satisfied.
- B. 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.
- C. Payment Application Times: Submit digital 'Pencil Copy' of Application for Payment to the Architect via established communication means by the 20th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month. Upon approval from the Architect, submit a copy of a notarized Application for Payment for certification by the Architect. Retain original copies for records purposes.
- 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 fully-executed Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Certified Payrolls: Prior to payment on any Application, Contractor to submit copies of certified payrolls for all applicable project personnel, including subcontractors, indicating compliance with the Prevailing Wage Rates contained and any other applicable requirements of the contract.
- F. 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 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.
 - 2. Provide summary documentation for stored materials indicating the following:

- a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
3. For materials stored off-site, provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
- G. Transmittal: Submit four signed and notarized original copies of each Application for Payment to the Architect via established communication means. Include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Lien: With each Application for Payment, submit Waiver of Lien from entities lawfully entitled to file a lien arising out of the Contract and related to the Work covered by the payment. Lien waivers will be required in addition to the Stipulation Against Liens between Contractor and Owner filed at the outset of the Contract.
 1. Submit partial waiver on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waiver.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that shall precede or coincide with submittal of first Application for Payment, including approval by Architect, where appropriate, include the following:
 1. List of all subcontractors including approximate percentage of total contract value ascribed to each.
 2. Qualified Contractor Certification forms for each major subcontractor.
 3. Schedule of values.
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Submittal schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Certificates of insurance and insurance policies.
 11. Performance and payment bonds.
 12. Other submittals specifically identified in these Contract Documents as having to be approved prior to Initial Payment or Approval of Initial Payment Application.

- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
 3. If retainage is reduced prior to Final Payment, submit AIA Document G707A, "Consent of Surety to Partial Release of Retainage."
 4. Administrative actions and submittals that shall precede or coincide with this application include:
 - a. Occupancy permits and similar approvals
 - b. Warranties and maintenance agreements
 - c. Maintenance instructions
 - d. Test, adjust, and balance records
 - e. Startup performance reports
 - f. Changeover information related to Owner's occupancy, use, operation, and maintenance
 - g. Application for reduction of retainage and Consent of Surety
 - h. Advice of shifting insurance coverages
 - i. Final cleaning
 - j. List of incomplete Work; recognized as exceptions to the Scope of Work
 - k. Record documents
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages and penalties settlement statement.
 10. Removal of temporary facilities and services
 11. Removal of surplus materials, rubbish, and similar elements.
 12. Evidence of required maintenance materials and attic stocks.
 13. Completion and correction of punch list items
 14. Change of door locks to Owner's access.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Start-up and project organization.
 - 2. General coordination procedures.
 - 3. Coordination of project space.
 - 4. Submittals.
 - 5. Coordination.
 - 6. Requests for interpretation (RFIs).
 - 7. Project meetings.
 - 8. Safety.
- B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific Contractor. Certain areas of overall coordination responsibility are assigned to the Lead Contractor.
- C. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
 - 2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking interpretations or clarifications of Contract Documents.
- B. Frivolous RFIs: When Contractor forwards multiple RFIs that include inappropriate questions, means and methods, substitution requests, repeating questions, and submitting RFIs where information is clearly indicated on Contract Documents.

1.3 START-UP, PROJECT ORGANIZATION

- A. Architect authority includes establishing on-site lines of authority and communications:
 - 1. Construction Manager will have authority in matters concerning the coordination of all aspects of the project.
 - 2. Schedule and conduct a pre-construction meeting and project meetings as specified.
 - 3. Enforce Contract Documents requirements and immediately report deficiencies in writing to Owner.

4. Approve procedures for project communications:
 - a. Submittals.
 - b. Reports and records.
 - c. Recommendations.
 - d. Coordination drawings.
 - e. Schedules.
 - f. Resolution of conflicts.
 5. Conduct inspections at Substantial Completion of each Contract, to assure that:
 - 1) Specified cleaning has been accomplished.
 - 2) Temporary facilities have been removed from site.
 - 3) Conduct an inspection to confirm or supplement Contractor's list of work to be completed or corrected.
 - 4) Prepare punch list(s).
 - 5) Verify correction and completion of work as established in Certificate of Substantial Completion.
 6. Assemble documentation for handling of claims and disputes.
 7. Final Completion:
 - 1) When each Contractor determines that work is finally complete, conduct a final inspection to verify completion of work.
 8. Administration of Contract close-out:
 - 1) Receive and review Contractor's final submittals.
- B. Lead Prime Contractor authority includes:
1. Control site use:
 - a. Allocate space within the building for each Prime Contractor's use for field offices, sheds, work and storage areas.
 - b. Establish locations for access, traffic, and parking allocations and regulations.
 - c. Monitor use of site during construction.
 2. Observe the Work at all construction phases and for all Contracts to ensure proper coordination between Prime Contracts.
 3. Maintain reports and records at job site, available to Architect and Owner:
 - a. Daily log of progress of work of each Contractor.
- C. Each Contractor shall:
1. Coordinate its own Work, schedules, and progress of Work with other Contractors and subcontractors.
 - a. Ensure proper fitting of Work, both new or existing materials and substrates.
 - b. Manage operations of various trades, subcontractors, and laborers employed to perform the Work of its Contract.
 - c. Provide to each subcontractor the dimensions that may be required for fitting of its work to surrounding work.

- d. Fitting the work to receive or to be received by other Contractors.
- 2. Monitor and document use of Temporary Utilities:
 - a. Verify that adequate services are provided and maintained.
- 3. Coordinate use of Owner's facilities.
- 4. Perform applicable Close-out Duties assigned to it per the drawings and specifications.
 - a. Mechanical and electrical equipment start-up:
 - 1) Coordinate checkout of utilities, operational systems, and equipment.
 - 2) Assist in coordinating initial start-up and testing.
 - 3) Record dates of start of operation of systems and equipment.
 - 4) Submit to Owner, written notice of beginning of warranty period of equipment put into services.

1.4 GENERAL COORDINATION PROCEDURES

- A. Each Prime Contractor shall carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Architect of any apparent error, inconsistency, omission or discrepancy discovered.
 - 1. Coordinate scheduling, submittals, and Work results described in various Specification sections to avoid conflicts and ensure efficient and orderly sequence of installation of interdependent construction elements.
 - a. Coordinate Work of various Specification sections having interdependent responsibilities for installation, connection, and operation.
 - b. Verify that characteristics of operating equipment are compatible with building utilities and services.
 - c. Prepare coordination documents in a timely manner and distribute as required.
 - 2. 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.
 - a. 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.
 - b. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - c. Coordinate Work of various Specification sections having interdependent responsibilities for installation, connection, and operation.
 - d. Verify that characteristics of operating equipment are compatible with building utilities and services.
 - e. Make adequate provisions to accommodate items scheduled for later installation.
 - f. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of components, including mechanical and electrical.
- B. The General Contractor is designated as the Lead Prime Contractor for the Project. Each contractor shall coordinate its construction operations with those of other contractors and

entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own completion.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Coordinate Work of various Specification sections having interdependent responsibilities for installation, connection, and operation.
 4. Verify that characteristics of operating equipment are compatible with building utilities and services.
 5. Make adequate provisions to accommodate items scheduled for later installation.
 6. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of components, including mechanical and electrical.
- C. Claims resulting from improper coordination are limited to additional time. Refer to General Conditions.
- D. 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.
- E. Prepare similar memoranda for Owner and Architect, and separate Contractors if coordination of their Work is required.
- F. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Construction Schedule.
 2. Preparation of the Schedule of Values.
 3. Installation, maintenance, and removal of temporary facilities and controls.
 4. Delivery and processing of submittals, including coordination drawings.
 5. Project and coordination meetings.
 6. Pre-installation conferences.
 7. Updating, coordination and submittal of record documents.
 8. Startup and adjustment of systems.
 9. Project closeout activities.
- G. Administrative Personnel: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work. Include special personnel required for coordination of operations with other Contractors.
- H. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

- I. Closeout: Coordinate completion and clean up of Work in preparation for Substantial Completion and for portions of Work designated for partial occupancy.
 - 1. Minimize disruption of Owner's activities after occupancy of premises by coordinating access to site by various trades for correction of defective Work and Work not in accordance with Contract Documents.
- J. Multiple Contract Coordination: Comply with previous Paragraphs in the Article, where each Contractor shall coordinate and document its construction operations with those of other Contractors and other project entities.
 - 1. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.

1.5 COORDINATION OF PROJECT SPACE

- A. General: Coordinate use of Project space and sequence of installation of fire suppression, plumbing, mechanical, and electrical Work. Follow schematic routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space. Make material runs parallel with building lines.
- B. Utilize space efficiency to maximize accessibility for other installations, maintenance, and repairs.
- C. Coordinate installation to prevent conflicts and cooperate in making, without extra charge, reasonable modifications in layout as needed.
- D. Provide unimpeded access, with maximum head room, to control points, valves, strainers, control devices, and specialty items of every nature related to such systems and equipment. Provide adequate clearances as necessary for operation and maintenance.
- E. Conceal pipes, ducts, conduit, and wiring within construction, except as otherwise indicated. Coordinate locations of fixtures, devices and outlets with finish elements.
- F. Layouts of fire suppression plumbing, mechanical, and electrical systems, equipment, fixtures, piping, ductwork, conduit, specialty items, and accessories indicated on utility Drawings are diagrammatic. Variations in alignment, elevation, and details required to avoid interferences and satisfy architectural and structural limitations are not necessarily indicated.
 - 1. Prior to installation of material and equipment, review and coordinate Work of all Drawings to establish minimum space conditions.
 - 2. Prepare Coordination Drawings where required to coordinate Work.
 - 3. Sequence the Work between Contractors to allow for efficient installation.
 - 4. Conduct ad hoc pre-installation conferences where required to coordinate Work.
 - 5. Where available space is inadequate or where reasonable modifications are not possible, request information from Architect before proceeding.
 - 6. Clearly document all deviations or changes from design documents for reference by the Architect at the completion of the work.
- G. General order of priority for project space:
 - 1. Drain lines.
 - 2. Ductwork.
 - 3. Fire Suppression Piping.
 - 4. Other mechanical piping.

5. Other plumbing piping.
6. Electrical conduit.

1.6 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Within 15 days of receipt of the executed Contract, submit a written summary identifying all 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 Sections 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.
 1. Identify Project Manager, Superintendent, Scheduling Consultant, and other Project staff. For each Key Personnel list: work addresses; list telephone numbers, including home, office, and cellular telephone numbers; list e-mail addresses.
 2. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of Key Personnel.
 3. Post copies of list of Key Personnel in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
 4. Provide supervisory personnel consistent with project size and complexity, who shall be fully capable of controlling their workers and subcontractors, coordinating work through Construction Manager, working in harmony with other trades, and completing work in accordance with Construction Schedule.

1.7 REQUESTS FOR INTERPRETATION (RFIs)

- A. Allot time in construction scheduling for liaison with Architect; establish procedures for handling queries and clarifications. Use only established communication means for requesting information.
- B. Immediately on discovery of need for additional information or interpretation of Contract Documents, and if not possible to request interpretation at a Project meeting, prepare and submit an RFI to the Architect.
- C. Contractor shall remain responsible for a complete Request for Interpretation with knowledge that in the event that RFI is NOT complete, they are still responsible for detailed, accurate, and complete information prior to Architect's review and response.
 1. RFIs shall originate with Contractor or Owner and be submitted to the Architect.
 2. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 3. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- D. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name and number.
 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 paragraph references, 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 Contract Time or Contract Sum, Contractor shall state impact in RFI.
 11. Cost impact: (yes/no; dollar amount).
 12. Schedule impact: (yes/no; number of days).
 13. Contractor's signature.
 14. Attachments: Include drawings, sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- E. Architect's Action: Architect will review each RFI, determine action required, and respond via Procore.
1. Allow an average of ten calendar days for Architect's response for each RFI, as some RFIs will take longer to answer than others. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.
 2. 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 Contract Documents.
 - e. Requests for adjustments in Contract Time or Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 3. 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.
 4. Architect's action on RFIs that may result in a change to Contract Time or Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes RFI response warrants change in Contract Time or Contract Sum, notify Architect in writing within 10 calendar days of receipt of RFI response.
- F. On receipt of Architect's and Construction Manager's action, update RFI log and immediately distribute RFI response to affected parties. Review response and notify Architect within 10 calendar days if Contractor disagrees with response.
1. Lack of such notification shall be understood to mean that Contractor agrees with response.
 2. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

- G. Architect's Action: Architect will review each RFI, determine action required, and respond via Procore:
 - 1. A notification of processing fees using Architect's and Construction Manager's standard billing rates.
 - 2. Returning RFI unanswered with the notation: Not Reviewed.

1.8 CONFERENCES AND MEETINGS

- A. General: Various project conferences and meetings, as will held at Project site and shall be conducted as indicated in following paragraphs.
 - 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 meeting agenda. Distribute agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within five calendar days of the meeting.
- B. KICK-OFF MEETING: Architect will schedule and conduct a Kick-Off Meeting (preconstruction conference) before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its project manager and superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Review responsibilities and key personnel assignments.
 - b. Tentative construction schedule, including phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Lines of communications.
 - e. Review Startup Construction Schedule and Construction Schedule requirements.
 - f. Work by Owner, Work Under Separate Contracts, and Owner Related Products.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. Commissioning requirements
 - n. Closeout procedures and preparation of record documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions and working o.
 - q. Owner's occupancy requirements.
 - r. Site logistics.
 - s. Temporary utilities.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Parking availability.
 - x. Equipment deliveries and priorities.

- y. First aid, safety, and security.
 - z. Progress cleaning.
 - aa. Additional items, including contract, administrative and housekeeping procedures, responsibilities and priorities as determined by Construction Manager.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. PREINSTALLATION CONFERENCES: Each Prime Contractor shall conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction, and as required by Specifications.
- 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, and Contractors affected by subject construction activity, shall attend the meeting. Advise Architect and Owner's Agent(s) of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Construction Schedule and work time requirements.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Temporary utilities and environmental requirements.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

- D. OAC MEETINGS: Architect will conduct progress meetings at bi-weekly intervals, unless otherwise indicated. Project meetings are in addition to specific conferences and meetings held for other purposes.
1. Meeting dates may be coordinated 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. Meeting participants 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. Agenda includes the following:
 - a. Safety.
 - b. Administrative.
 - c. RFIs
 - d. Submittals.
 - e. Schedule.
 - f. Project Changes.
 - g. General.
 4. Minutes: Architect will record and distribute the meeting minutes to each party present and to parties requiring information.
- E. WEEKLY PLANNING MEETINGS: Lead Prime Contractor shall conduct weekly planning meetings which all prime contractors are to attend and participate in. Weekly planning meetings are in addition to specific meetings held for other purposes, such as project meetings and preinstallation conferences.
1. Attendees: Each Contractor's field superintendents, 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. Meeting participants shall be familiar with Project and authorized to conclude matters relating to the Work. Attendance by Owner and/or Architect is at their discretion.
 - a. The Owner reserves the right to deduct from future pay applications or the final retention, for the continued absence or non-compliance of any contractor not to participate in the weekly planning meetings following a scale of:
 - 1) 1st meeting absence = \$0
 - 2) 2nd meeting absence = \$500
 - 3) 3rd meeting absence = \$750
 - 4) 4th meeting absence = \$1000
 - 5) 5th and subsequent meeting absence = \$1,250/each
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule:
 - 1) Review progress since last coordination meeting.
 - 2) Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule.
 - 3) Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so.

- 4) Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within Contract Time.
 - b. Schedule Updating: Revise Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised Contractor's Construction Schedule concurrently with report of each meeting.
 - c. Update the planning board in the Lead Prime Contractor's field office.
 - d. Review present and future needs of each Contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access and site utilization.
 - 7) Temporary facilities and controls.
 - 8) Work hours.
 - 9) Hazards and risks.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Change Orders.
 3. Minutes: Lead Prime Contractor will record and distribute the meeting minutes to everyone in attendance, the Architect and to others affected by decisions or actions resulting from each meeting.
- F. Warranty Meeting: Prior to the expiration of the one (1) year project warranty, Architect will conduct and each Prime Contractor shall attend a meeting with the Owner to review the facility operations and performance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements for schedules and reports required for proper performance of the Work.
 - 2. Construction Schedule Management.
 - a. Base line bid schedule
 - b. Construction phase – Project schedule development
 - c. Construction phase – Project schedule sign-off
 - d. Construction phase - Responsibilities for updating
 - e. Construction phase – Recovery schedules
- B. Related Sections:
 - 1. Section 007216.01 – General Conditions
 - 2. Section 011100 - Summary of Work.
 - 3. Section 012000 - Payment Procedures.
 - 4. Section 013100 - Project Management and Coordination.
 - 5. Section 013300 - Submittal Procedures.
 - 6. Section 014000 - Quality Requirements.

PART 2 - PRODUCTS

2.0 BASE LINE BID SCHEDULE

- A. The Lead Prime Contractor shall be responsible for development of the CPM (Critical Path Method) Schedule as specified in this section and each Prime Contractor shall abide, participate and sign off on the final construction schedule after participating in the development and refinement from the base line bid schedule.
- B. It is acknowledged that the schedule service provided by the Construction Manager is that of a facilitator and the Construction Manager bears no responsibility for any and all schedule performance, errors, omissions or the lack of cooperation and management of any prime contractor's schedule information provided or the work performed.
- C. All Prime Contractors acknowledge that the Completion Dates set forth in the contract documents represent only the major items of Work and may or may not include interface dates with the construction activities of the other Prime Contractors or others. Each Prime Contractor shall determine the time requirements for all such interfaces and shall be responsible for planning, scheduling and coordinating the Work in order to complete in accordance with those requirements and the governing milestone dates.

2.1 CONSTRUCTION PHASE - PROJECT SCHEDULE DEVELOPMENT

- A. It shall be the responsibility of each Prime Contractor to cooperate fully with the Lead Prime Contractor to create and update the CPM Schedule. CPM Schedule, including updates, will reflect the input of each Prime Contractor as to sequences, durations, construction logic, and means and methods of construction. Each Prime Contractor shall provide persons of sufficient skill and information of sufficient details and scope of work understanding to enable Construction Manager to prepare and update Project Construction Schedule.

- B. All contractors acknowledge that the Lead Prime Contractor at their discretion may use a third party scheduling consultant to assist with the development, updating and the management of the contract schedule. All Prime Contractors acknowledge and agree to the following:
1. They will provide competent onsite managers who are authorized and have the project knowledge to attend schedule review meetings and work directly with the scheduling consultant to create, edit, update and maintain their specific scope of work schedule information.
 2. Schedule updates shall be performed on a weekly, by weekly and/or monthly basis. Each Prime Contractor shall receive, fill out and return, in the specified time frame, the schedule update sheets as issued by the Lead Prime Contractor on the dates established by the Construction Manager
 3. Each Prime Contractor shall follow up each submission of their schedule updates with their attendance at the following scheduled project meeting meeting at which they will participate in all discussions, coordination, issue resolutions and working sessions with the CM and all other prime contractors.
- C. Project Construction Schedule Development: Within (21) days of award of Contracts to Primes, the Lead Prime Contractor will issue request for Project Schedule information. All Contractors must provide their major items of Work as outlined below within (10) days of receipt of the Lead Prime Contractor's schedule. The Lead Prime Contractor shall issue a working Project Schedule within (14) days of receipt of major Work items from other Contractors.
- D. Each Prime Contractor is responsible for determining the sequence and logic of activities, the time estimates of the detailed construction activities and the means, methods, techniques and procedures to be employed with regard to their portion of the Work. The Lead Prime shall represent their best judgment, with the Prime Contractor's input of how to sequence the Work in compliance with the requirements of the Contract Documents.
- E. Each Prime Contractor shall consult with their major subcontractors and vendors relating to the preparation of their initial and final construction schedules. Each Prime Contractor shall be solely responsible for ensuring that all subcontractors comply with the requirements of the Contractor's Construction Schedule for their portions of the Work.
- F. Each Prime Contractor shall provide the activity data as required by the Lead Prime Contractor relating to activities, durations and sequences as part of the Prime Contractor's initial Contractor's Construction Schedule. This data shall reflect the Prime Contractor's actual construction plan for the Project, and shall fully comply with all requirements of the Contract Documents for the established milestone dates in the bid.
- G. Each Contractor shall submit their data in a form or format as specified by the Lead Prime Contractor within (10) days of receipt of its schedule input request.
- H. The Completion Dates set forth in the Contract Documents represent only the major items of Work and may or may not include interface dates with the construction activities of the other Prime Contractors or others. Completion Dates are Contract requirements and are the essence to the Contract Documents for the coordination of the Work by the Prime Contractor. Completion Dates represent the latest allowable completion time for those portions of the Work to which each Completion Date relates. The Completion Dates are not intended to be a complete listing of all Work under the Contract Documents or of all interfaces with work performed by other Prime Contractors or others. The Prime Contractor shall determine the time requirements for all such interfaces and shall be responsible for planning, scheduling and coordinating the Work in order to complete their work in accordance with those requirements. The reporting of "Total Float" on any schedule updates does not specify

ownership by the Prime Contractors. Positive Float for any Phase of the project shall always fall to the bottom line to benefit the Owner's occupancy.

- I. Unless otherwise specifically provided in the Contract Documents, and in particular the General Requirements, the Prime Contractor acknowledges that the Owner and Architect have contemplated in their planning and in any preliminary schedule that may have been prepared and made available to the Bidders, and in their budgeting for professional services, that the Work shall be performed on a 5-day work week basis, utilizing a single 8-hour shift per day. The Owner and Construction Manager shall have the sole discretion of approving or rejecting a variance in the work week, number of shifts, or shift length. Unless otherwise agreed to by the Owner or Architect, the Prime Contractor shall bear the cost of, and pay the Owner, for additional staff and supervisory personnel and inspectors of any authority having jurisdiction of the Work, necessary to support any variance in the contemplated work week, number of shifts or shift length, caused by the prime contractor's inability to complete the work during the original allotted time.
- J. The Lead Prime Contractor and the Prime Contractors shall work together to prepare the Project Initial Schedule, incorporating all site, utility, building and off-site activities of work, and the activities of the Owner, Architect and Multiple Prime Contractors on the Project, for all phases of the Work including, but not limited to:
 1. Activity sequences and durations following the Work Breakdown Structure (WBS) specifics to each Prime Contractors specific tasks for every phase of the project;
 2. Processing of Submittals for Shop Drawings, Product Data and Samples. A time allowance should be included in construction activities to allow for submittal, procurement, fabrication and delivery process;
 3. Delivery and procurement of products, materials and equipment, including those that must be ordered well in advance of construction;
 4. Building close-ins and start of temporary heating (as applicable) per each phase and designated building area.
 5. Milestone dates for final cleaning for each phase
 6. Milestone date for owner to commence the installation of their furnishings, fixtures and equipment; for each phase.
 7. Punch List creation and contractor completion
 8. Submission of close-out documentation
 9. Milestone dates for all, and individual, tests and inspections for each trade
 10. Substantial Completion
 11. Final Completion.
- K. For each activity, provide duration in working days. Each major item of work shall be fully broken down by the Prime Contractors on individual line items by site, phase, floor area and other exact portion of the work areas. Single references grouping major areas of work will not be accepted.
- L. The final Project schedule shall include the Owner's occupancy requirements showing portions of the Project having occupancy priority, sequencing and phasing as established in the contract documents and the site logistics plan.
- M. In the event of disputes or disagreements among Prime Contractors regarding the Project schedule, the status or any coordination item for the Work, the Lead Prime Contractor shall have final authority to resolve such issues within the constraints of the project milestone dates established by the Contract Documents. In the event that any Prime Contractor fails to abide by the resolution as determined by the Lead Prime Contractor, the Lead Prime Contractor shall promptly report the situation to the Owner and the Architect for further action available under the contract documents, which may include but not be limited to the non-

processing and funding of payment applications for a prime contractors noncompliance and participation in any part of the schedule management process.

1. It is acknowledged that the Lead Prime Contractor, at their discretion, may coordinate intermediate and break-out schedules for items such as the abatement, demolition, the addition, utility phase transitions and other schedule sequences requiring separate attention.
2. Within 15 days of receipt of the preliminary expanded initial construction schedule, all Prime Contractors shall return their schedule information, then attend a working session on site with the Lead Prime Contractor during which the full Construction Phase Schedule will be reviewed and developed. Attendance is required by all prime contractors at the schedule coordination meetings, whose representatives have the full authority to provide schedule input and decisions for the Contractors.
3. The Contractor's failure to complete their schedule responsibilities within this time frame shall enable the Owner to pursue a delay claim and other damages should the Contractor's non-participation in the schedule development and updating process lead to any delay or added project costs.

2.2 CONSTRUCTION PHASE - PROJECT SCHEDULE SIGN OFF

- A. The Architect shall dictate the time for the completion and acceptance of the final schedule, but in no case shall it exceed 60 days from the issuance of the first working schedule and request for contractor information.
- B. All Prime Contractors are required to witness their approval by returned signature on a schedule acceptance letter form, issued by the Lead Prime Contractor, and returned to the Lead Prime Contractor within five (5) days of receipt. Failure to participate and cooperate in the initial and final working meetings for the schedule and the sign-off for the final schedule will result in that party being designated as being in non-compliance with the contract and trigger any and all actions available to the Owner under the contract documents including, but not limited to the requests for the replacement of the Prime Contractor managers, withholding of monthly payments until such time full compliance with the scheduling process is provided and determined to be sufficient by the Lead Prime Contractor. The accepted schedule will be considered a contract document and shall be the one source of schedule coordination and progress reporting for the records and all contract related functions including all penalties.
- C. Upon written approval of the schedule by each Contractor, it shall, with respect to time, become of the essence of the Contract in regard to Contractor's performance of the Work and any Contractor who does not comply with the schedule may be held in violation of Article 8, Paragraph 8.2, Progress and Completion. The Project Schedule may be changed or revised only with the written consent of all Contractors and the Owner. If the General Construction Contractor or other separate Contractors do not comply with all the above requirements and time lines, the Owner reserves the right to deduct \$500.00 from the Contract amount for each day that Contractor does not comply and Owner may also proceed with enforcing other requirements of the Contract as outlined in Specification Section 007216.01. The aforesaid deduction shall be in the nature of liquidated damages and not as a penalty as actual damages resulting from Contractor's failure to comply with the above requirements and time lines are impossible to determine.

2.3 CONSTRUCTION PHASE – RESPONSIBILITIES FOR UPDATING

- A. The Lead Prime Contractor shall perform all schedule updates utilizing update forms that they distribute and collect from the Prime Contractors.

- B. During the construction phase, the Lead Prime Contractor shall review and monitor the work. All Prime Contractors will coordinate their weekly planning meetings, including their two and six week look-ahead schedules and all site disturbance planning with the current schedule updates.
- C. On a monthly basis, after receipt the Prime Contractors schedule update sheets, The Lead Prime Contractor shall provide monthly updates of the Project schedule as required to show current conditions. If an update indicates that the previously approved Project Schedule may not be met, the Lead Prime Contractor shall recommend corrective action in writing, if any, to the Owner, Architect and Contractor(s).
- D. The progress schedule update sheets shall be submitted by the Lead Prime Contractor every Two Weeks, or at a frequency of their discretion, for updating the construction progress schedule. This shall be further reviewed and discussed at the bi-weekly Owner, Architect and Contractor's coordination meetings.
- E. Weekly Planning Process – As part of the Weekly Planning Process, the updated schedule shall be used by the Lead Prime Contractor and all Prime Contractor foremen to update and plan each week's work. Each foreman is responsible to fully participate in all processes as follows:
 - 1. Complete and update, on each Monday morning, the weekly planning boards that will identify each day's major items of work and the percentage goal to have completed each Friday.
 - 2. Openly discuss coordination of your work with all other Prime Contractors present during the Monday meetings at the weekly planning board.
 - 3. Perform Friday updates to the weekly planning board – list the actual percent complete for individual work activities compared to the set goals. Plan for the following Monday meeting discussions.
 - 4. Coordinate planning with the Construction Manager and the other Prime Contractors to create, update and maintain a Two and Six Week Look Ahead list of your major work activities. These lists will be entered by each foreman on the visual display boards in the Colocation field office.
 - 5. Identify and list at the weekly Monday AM meetings all major deliveries for your work. All deliveries shall be fully coordinated by the Prime Contractor foremen observing all rules and guidelines of the site safety and logistics plan and the Owner's daily site schedule for bus arrival and departures, parent drop offs and other school activities.
 - 6. Attend and participate in the weekly Owner Disturbance Meeting as scheduled by the Construction Manager. Be fully prepared to discuss you work for the week and the potential for it to create out of the ordinary disturbance to classroom activities and other school functions.
- F. Changes to the project that result in a requested extension of Time change order by a Prime Contractor shall be reviewed during the change order review process. Primes will be required to submit activities and durations for changes and the Lead Prime Contractor will incorporate into the project schedule for analysis. Only those changes that affect the critical path would result in an extension of time.
- G. Free float or any other measurement of schedule progress shall not be used on this project.
- H. Negative Float is an indication that an activity is not progressing at the assigned rate and can impact the successor activity and the completion of the Substantial Completion of a phase and/or the entire project.
- I. All Prime Contractors acknowledge that when any of their activities reach a minus fourteen (-

14 days) of Total Float, they will be responsible to prepare, enact and manage a Recovery Schedule.

2.4 CONSTRUCTION PHASE – RECOVERY SCHEDULES

- A. Should the updated Prime Contractor's Construction Schedule, at any time during the Prime Contractor's performance of the Work, show in the sole opinion of the Owner and/or Architect that the Contractor is fourteen (14) or more days behind schedule on any Completion Date, or should the Prime Contractor be required to undertake actions as provided for in these specifications, with or without the direction of the Lead Prime Contractor, the Prime Contractor shall prepare and submit a Recovery Plan and schedule explaining how they intend to manage, schedule, adjust and coordinate their Work in order to regain compliance with the overall critical path of the main construction schedule.
- B. All Recovery Schedule submissions shall be accomplished by the Prime Contractor during the immediate subsequent pay application period.
- C. The Prime Contractor's submitted plan to recover lost schedule time shall include, but not be limited to: using additional manpower; using a second shift crew; working weekends; adding subcontractors; working extended and overtime hours; resequencing of the work.
- D. The Prime Contractor's recovery schedule shall be presented to the Owner, Construction Manager and the other Prime Contractors within ten (10) days of the request for the Recovery Schedule submission. This recovery Plan shall be submitted and presented by the Prime Contractor, in person at an onsite meeting.
- E. Upon receipt and review, the Owner, at their sole discretion, and in consultation with the Architect, shall accept, reject or request modifications to the submitted Recovery Schedule and plan.
- F. In no case, shall the Prime Contractor submit a Recovery Schedule that exceeds a thirty (30) day duration to recover the lost time, unless agreed to in writing by the Owner and the Architect.
- G. It is acknowledged that the submission of a Recovery Schedule is intended to permit the work progress to return to that prescribed in the main governing construction schedule at the earliest possible time.
- H. Should the Recovery Schedule and plan receive the acceptance of the Owner and or Architect, the Prime Contractor shall be solely responsible to manage and coordinate the recovery activities with all of their forces, the work of their subcontractors and vendors and that of the other Prime Contractors.
- I. The Prime Contractor's foreman submitting the Recovery Schedule shall report on the progress of the recovery activities at each Monday weekly planning meeting.
- J. All costs associated with the formation of any Recovery Schedule and plan shall be the sole responsibility of the Prime Contractor causing the delay.
- K. The acceptance of any Recovery Plan by the Owner and/ or Architect in no way changes any Contract requirements for the Prime Contractor to comply with any and all schedule requirements of the contract documents.
- L. Failure of any Prime Contractor to fully comply with the submission, execution and

management of the Recovery Schedule process, as determined by the Architect, may result in the reduction or withholding of that periods pay application and funding, until the contract terms for Recovery are met.

- M. The Prime Contractor shall also report Recovery progress at the Bi-Weekly progress meetings. If the Architect and or Owner determines that the Prime Contractors has not started, is not in compliance with their proposed schedule and recovery methods within 30 days of issuance of the plan, the Architect shall formally notify the Prime Contractor that they are now in a project delay situation and any and all remedies available to the Owner in other areas of the contract agreement shall be pursued to limit or eliminate the continuing delay.
- N. If the Owner, or Architect, determines that the Prime Contractor has successfully complied with the provisions of the Recovery Schedule and plan, the Architect will direct the Prime Contractor to return to the use and management of the base main construction schedule.
- O. Nothing herein the Recovery Schedule plan alters the rights of the Owner or the Architect to resolve coordination and scheduling issues in dispute between and among the Contractor and the other Prime Contractors.
- P. Any delay claims submitted without a detailed schedule showing the exact impact to The Substantial Completion Date for any actions caused by the Owner, shall be considered to be unsubstantiated and without merit including those claims submitted that do not meet the requirements of the contract documents.

2.5 CONSTRUCTION PHASE – GENERAL SCHEDULE REQUIREMENTS

- A. The primary objectives of the requirements of this Section are:
 - 1. To insure adequate planning and execution of the Work by the Prime Contractor by having a schedule of construction activities for all of the Prime Contractors and their subcontractors.
 - 2. To assist the all contractors in evaluating progress of the Work.
 - 3. To provide for optimum coordination by Prime Contractors of their trades and subcontractors, and of their Work with the work or services provided by other Prime Contractors and the Owner's Contractors and Vendors.
 - 4. To permit the timely prediction or detection of events or occurrences which may affect the timely prosecution of the Work.
 - 5. To provide a mechanism or tool for use by Owner, Architect and the Lead Prime Contractor to monitor any actions of Prime Contractors which may be required to comply with the requirements of the Contract Documents relating to the completion of the various portions of the Work by the Completion Dates specified in the Contract Documents.
- B. Schedule Management and Meetings
 - 1. All Prime Contractors acknowledge that other meetings for safety, pre-installations, Owner disturbance planning as well as others, can occur at unspecified intervals.
 - 2. All Prime Contractors shall attend personally or be represented at all meetings stated above. Subcontractors and other vendors will be required to attend as conditions and agenda topics warrant. All Prime Contractor representatives shall have the ability and responsibility to fully represent their company at these meetings and have the project knowledge and authorization to collaborate and make

commitments and decisions on behalf of their companies. In dealing with the Prime Contractor's representatives, the Owner, Architect and their consultants and agents shall do so with the full assurance that such representative's actions will be accepted the same as though the Prime Contractor who signed, and is bound by the contract, were itself present and personally made such agreements and commitments. All Prime Contractors, their subcontractors and vendors are required to be on time for the commencement of each meeting and remain for the full duration of the meeting until it is adjourned by the meeting leader or receives permission to depart from same. It is each Prime Contractor's responsibility to review all meeting minutes and other articles for each meeting and schedule and coordinate their work, and that of their subcontractors and will be responsible for the outcome of their needed actions from the meeting whether in attendance or not.

- C. The Prime Contractor acknowledges and agrees that their Construction Schedule must be flexible in order to accommodate and allow for their coordination with the construction activities of the other Prime Contractors.
- D. The review by the Owner or Architect of the Prime Contractor's Construction Schedule submissions or any other schedule or plan of construction of the Prime Contractor, does not constitute an agreement by the Owner or Construction Manager of any start or finish date in the schedule or specific durations or sequences for activities of the Prime Contractor; further, nothing herein shall be construed as modifying or changing, or excusing the performance of the Prime Contractor of required portions of the Work by the Completion Dates as set forth in the Contract Documents.
- E. Should the Prime Contractor intend or plan to complete the Work, or any portion thereof, earlier than any applicable Completion Date or the Contract Time, the Prime Contractor shall give timely and reasonable notice of this fact to the Construction Manager. The Construction Manager shall have the discretion to agree to or reject such early completion plan by the Prime Contractor, subject to the rights of the Prime Contractor as stated in these specifications. The Architect and Owner shall have no duty or obligation to agree to, or to cooperate with the Prime Contractor regarding any early completion plan or proposal by the Prime Contractor and shall not be liable for any damages of the Contractor because of the rejection by the Architect and/or Owner of said plan.
- F. Each Prime Contractor acknowledges the geographical location of the project and has considered the average prevailing weather conditions in their formation of their schedule activity durations and logic. Weather conditions are not an acceptable condition for a delay claim, unless otherwise expressed separately in the Contract Documents.
- G. Updating of Project Construction Schedule may result in changes in the dates on which activities are expected to be completed. Process of updating Project Construction Schedule does not constitute approval of requests for extensions of time and does not replace the process of seeking extensions in accord with Article 8 of the General Conditions, which provision will be strictly enforced.
- H. The review by the Architect or Owner of the Prime Contractor's Construction Schedule information or any other schedule or plan of construction of the Prime Contractor, does not constitute an agreement by the Owner of any start or finish date in the schedule or specific durations or sequences for activities of the Contractor; further, nothing herein shall be construed as modifying or changing, or excusing the performance of the Prime Contractor of required portions of the Work by the Completion Dates as set forth in the Contract Documents.
- I. It is understood that the Work shall be performed on a 5-day work week basis, utilizing a

single 8-hour shift per day. However, all Prime Contractors acknowledge that certain aspects of their work such as, but not limited to, abatement, demolition, utility service interruptions and connections are to be performed on second shift, off hours and/or weekends and has included sufficient labor and material costs in their bids to cover these work periods regardless if they are called out on the milestone bid, initial or final construction schedules.

- J. The Owner and Architect shall have the sole discretion of approving or rejecting a variance in the work week, number of shifts, or shift length. Unless otherwise agreed to by the Owner or Architect, the Prime Contractor shall bear all of the cost of, and pay the Owner, for additional staff and supervisory personnel and inspectors of any authority having jurisdiction of the Work, necessary to support any variance in the contemplated work week, number of shifts or shift length.
- K. Should any Prime Contractor desire to or be otherwise required to make modifications or changes in their method of operation, their sequence of Work or the durations of the activities in their portion of the main construction schedule, they shall submit a request to the Owner, and the Architect, together with written rationale for the revisions and a description of the logic for rescheduling the Work and how they will maintain the phased and final milestone Completion Dates. The Owner, and the Architect, will review, reject or request further information on the proposed schedule adjustments. The Prime Contractor requesting the revised schedule sequences and methods shall be responsible for all incurred costs, and time delays, for the scheduling revisions and the overall coordination instructing the Work of the other Prime Contractors. In no case shall the any Prime Contractor use this specification section to request a change to the contract completion dates.

PART 2 - PRODUCTS (Not Used.)

PART 3 - EXECUTION (Not Used.)

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements for Submittal Schedule and administrative and procedural requirements for submitting various project submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
2. Section 013100 "Project Management and Coordination" for Architect-provided digital documentation.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Construction Schedule.
4. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
5. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 DEFINITIONS

- A. Action Submittals:** Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action as so referenced in individual Specification Sections.
- B. Informational Submittals:** Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals so indicated in individual Specification Sections.
- 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.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule:** Using the submittal register list provided by the Construction Manager, provide dates for the submission of the submittal items required by the Construction Schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate Submittal Schedule with list of subcontracts, the Schedule of Values, and Construction Schedule.

2. Include the following information on Submittal Schedule for each submittal: planned submission date; planned submission return date (allow 21 days for submittal review); duration for ordering, manufacturing/fabricating, and delivery; expected delivery date; and date required on site.
3. Contractor shall be solely responsible for ensuring submittals are submitted early enough that resulting delivery of material or equipment does not delay Substantial Completion.
4. 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.
5. Final Submittal: Submit concurrently with the first complete submittal of Construction Schedule.
 - a. Submit revised Submittal Schedule to reflect changes in current status and timing for submittals.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings per specification section 013100 – Project Management and Coordination.
- 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 same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- 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 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 21 calendar 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 review is necessary, add an additional 15 days for submittal review.
 3. Resubmittal Review: Allow 21 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 28 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 28 days for review of each submittal. Submittal will be returned to Contractor via the Architect's established communication means.
 6. No extension of the Contract Time nor increase in Contract Sum will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
- 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 submittal number or other unique identifier, including revision identifier in format established by Architect.
 3. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number as coordinated with Construction Manager.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
 4. Metadata: Include the following information as keywords in electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- 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 and Construction Manager 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 and Construction Manager'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.

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. Upload electronic submittals as PDF electronic files directly to Architect's document management platform.
 - 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. Where digital certification consists of scans of physically signed and/or sealed paper documents, Contractors shall keep on file all originals for the duration of the contract. Such records shall be available for the Owner, Architect or Construction Manager's review upon requests.

2.2 ACTION SUBMITTALS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's 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.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
- 1. Preparation: 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.
 - h. Roughing-in and setting diagrams.
 - i. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 2. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - b. Electronic file to be scaled or otherwise formatted to print on sheets sized between 8-1/2 by 11 inches to 30 by 42 inches.
 - c. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.
 - d. Refer to Section 013100 "Project Management and Coordination" for requirements for coordination drawings.
- C. 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 color image file illustrating Sample characteristics, and identification information for record in addition to actual samples.
- 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout 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 the originating Contractor.
- 5. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
 - a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
- 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing full range of colors, textures, and patterns available, if not specified in individual specification Sections.
 - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.
- 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect will retain Sample set; the other shall remain on site for the duration of the project.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: 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 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.

2.3 INFORMATIONAL SUBMITTALS

- A. Prepare and submit Informational Submittals required by other Specification Sections.
 1. Submit each submittal electronically via the Architect's online document platform.
 2. Certificates and Certifications: Submit a notarized statement that includes signature of entity responsible for preparing certification signed by an officer or other individual authorized to sign documents on behalf of that entity.
- B. Construction Schedules: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- C. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- D. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- E. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- F. 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.
- G. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. 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.
- I. 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.
- J. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- K. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

- L. 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.
- M. 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.
- N. 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.
- O. 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.
- P. 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.
- Q. 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.
- R. 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.

2.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
- B. 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.
- C. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file signed and sealed by the

responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Contractor to retain physical original copies for duration of the work.
2. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
 1. Submittals received by Architect or Construction Manager without Contractor's approval stamp will be returned un-reviewed to Contractor. Contractor shall be responsible for time delays associated with improperly transmitted submittals.
- B. Approval Stamp: Stamp each submittal with a uniform approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

- A. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 1. Approved or Accepted: Where submittals are marked 'Approved' or 'Accepted', that part of the Work covered by the submittal may proceed provided it complies with requirements of Contract Documents.
 2. Approved as Noted or Accepted as Noted: Where submittals are marked 'Approved As Noted' or 'Accepted As Noted', that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of Contract Documents.
 3. Revise and Resubmit: When submittals are marked 'Revise and Resubmit', do not proceed with that part of the Work covered by the submittal. Revise or prepare a new submittal in accordance with notations and resubmit without delay.
 4. Rejected or Not Approved: When submittals are marked 'Rejected' or 'Not Approved', pursue actions so the submittal complies with Contract Document requirements and resubmit for review and approval.
- B. Informational Submittals: Architect will review each submittal and may opt 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 Contract Documents will not be reviewed and may be discarded.

3.3 INITIAL SUBMITTAL DUE DATES

- A. Construction Schedule: 45 days after Contract Execution, signed by all Prime Contractors.
- B. Schedule of Values: As required by Section 012900.
- C. Submittal Schedule: 10 days after Contract Execution.
- D. Submittal Submission: 30 days after Notice to Proceed.
 - 1. Due to the current and expected extended lead times for major materials and equipment - it is the prime contractor's responsibility to submit all required shop drawings and product information, other than those for project close-out, for approval within 30 calendar days of the issuance of the Notice to Proceed letter or the contract agreement. Submittals shall be considered incomplete if not inclusive of all information, drawings, specifications and samples for the proper review by the Architect and/or Engineer. The contractor's failure to submit within this time frame shall enable the owner to pursue a delay claim - and other damages should the contractor's submittal delay lead to extended schedule durations or added project costs.

END OF SECTION

SECTION 014000 - QUALITY REQUIREMENTS

1.1 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 Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect and 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.
- C. Related Requirements:
 - 1. Section 017000 "Execution" for cutting and patching.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.
- C. 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. Mockups shall remain in place until the Work represented by mockup either has been completed, or has progressed sufficiently to demonstrate compliance of the Work with mockup.
 - 2. Unless specifically permitted by Architect and Construction Manager, mockup will not be incorporated into finished Work.
 - 3. Specific mockup definitions:
 - a. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.

- b. Integrated Exterior Mockups: Mockups of exterior envelope erected at specified locations within the building to verify coordination between existing and new, consisting of multiple products, assemblies, and subassemblies.
 - c. Sample Mockups: Mockups of building materials and/or components for testing, on-site evaluation, and/or inspection of aesthetic effects prior to implementation in the construction.
- D. 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.
- E. 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.
 - 1. NRTL: Nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: Testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- F. Source Quality-Control Testing: Tests and inspections that are performed at source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific quality assurance or quality control tests, inspections, or both. Testing laboratory shall mean same as Testing Agency.
- I. 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).
- J. 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 or being in business continuously for three consecutive years; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and standards establish different or conflicting requirements for minimum quantities or quality levels, comply with most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: Quantity or quality level shown or specified shall be minimum provided or performed. Actual installation may comply exactly with minimum quantity or quality specified, or it may exceed minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior and laboratory 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.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.6 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:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" and "Quality Control" Articles to demonstrate their capabilities and experience. Include proof of qualifications in form of a recent report on inspection of 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 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection Schedule: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction.
 - 3. Owner-performed tests and inspections indicated in Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority if applicable.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 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, other conditions affecting installation, 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 and installation 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.
- 1.9 QUALITY ASSURANCE
- A. General: Qualifications Paragraphs in this Article establish minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: 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: 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: 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: Professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: NRTL, NVLAP, or independent agency with 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.
- H. Manufacturer's Technical Representative Qualifications: Authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: 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.
- J. Preconstruction Testing: Where Testing Agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities 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, and laboratory mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service electronically to Architect and Commissioning Authority, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

- K. Mockups: Before installing portions of the Work requiring mockups, build mockups as required by the individual Technical Specifications 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 or Construction Manager.
 2. Notify Architect and Construction Manager 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 and Construction Manager's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 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.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified Testing Agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with Contract Documents will be charged to Contractor, and Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities 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.
 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. Whether quality-control services are assigned to Owner or Contractor, Contractor is responsible for notifying Testing Agency(ies) at least one work day 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, electronically, of each quality-control service.

5. Testing and inspecting requested by Contractor and not required by Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Submit written report, electronically, of each quality-control service.
- D. 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.
- E. Retesting/Reinspecting: Contractor shall be responsible for all costs of quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with Contract Documents.
- F. 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 Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Contractor shall 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.
- H. 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.

1.11 SPECIAL TESTS AND INSPECTIONS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 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 Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of assignment of responsibility for quality-control services.

END OF SECTION

SECTION 015100 - TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General administrative and procedural requirements governing temporary utilities including, but not limited to, the following:

1. Definitions.
2. Temporary Utilities:
 - a. Water.
 - b. Heating, Ventilating, Cooling, and Dehumidification.
 - c. Electricity.
 - d. Lighting.
 - e. Communication Services.
 - f. Fire Protection.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 011200 "Multiple Contract Summary" for general identification of Work in each Contract.
3. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

- A. Building Enclosure or Major Unit Enclosure: When status of construction includes the following:

1. Roof: Permanent roof is installed and in a waterproof condition.
2. Exterior Walls: Walls are erected and watertight.
3. Exterior Openings: Windows and doors are enclosed with either permanent materials and weathertight, or temporary weathertight closures.
4. Mechanical Substrates: Substrate for permanent heating units are completed and ready for installation of mechanical equipment.

- B. Major Unit: A wing or section of building, as indicated in the Construction Drawings.

- C. Major Unit Barrier: Temporary construction providing a weathertight closure between a Major Unit Enclosure and building area(s) that are not enclosed.

- D. Mechanical Room: Be enclosed with floor at time HVAC Contractor can install new heating system in a manner to permit its use for supplying heat during construction period.

1.3 TEMPORARY WATER SERVICE

- A. Plumbing Contractor shall provide, operate, and maintain temporary water service required for construction operations. Take necessary measures to conserve water usage by all workmen at site.
 - 1. Owner shall pay for water consumption costs.
 - 2. Plumbing Contractor shall pay all other costs associated with providing, maintaining and removing temporary water service.
- B. Install and maintain temporary water for duration of construction period. Provide water service from existing building supply with minimum 1-1/2 inch water line. Provide other required temporary water equipment located as necessary for adequate usage by workmen at site, including but not limited to: frost free concrete washout pit, wheel wash station, and masonry mortar mixing station, as coordinated with Contractors.
- C. Tie into existing building supply or bring temporary water supply to a point approximately 10 feet from existing building as coordinated by Architect.
- D. Supply temporary water within 14 calendar days after written request from any Contractor, or directed by Construction Manager.
- E. Install backflow preventers to prevent water line contamination, and methods to prevent freezing of water service including the point of termination.
- F. Install valve on temporary water service to allow for isolation from primary service.
- G. Plumbing Contractor shall provide a male NPT threaded fitting and threaded cap at the point of termination.
- H. Other Contractors shall be responsible to install, valve, maintain, and protect temporary water lines from the Plumbing Contractor's point of termination. Each Contractor is responsible for providing and securing required valves, fittings, reducers and hoses to perform their own Work.
- I. Keep temporary water supply in service until it is no longer required by the Work.

1.4 TEMPORARY HEATING, VENTILATING, COOLING, AND DEHUMIDIFICATION

- A. HVAC Contractor to provide, operate, and maintain temporary heating, ventilating, cooling and dehumidification throughout the Construction.
- B. Maintain temperature range between 55 – 90 degrees F. in work areas as work is in progress or completed and requires environmental conditioning for proper curing and protection regardless of exterior temperatures. Coordinate required conditions with installing contractors.
- C. Owner shall pay for utility-provided energy costs (electricity or natural gas consumption cost) for temporary heating. Contractor providing temporary heat shall pay for all other energy costs.
 - 1. If electric resistance type heaters are used for temporary heating, then appropriate Contractor shall be responsible for providing and paying for a separate metered service and related electrical items, including wiring, of proper size to operate the heaters.

- D. When building envelope is open to outside, General Contractor shall provide temporary enclosures as required to maintain separation between conditioned and unconditioned areas of the building to protect the finished Work or facilitate additional temporary heating measures until the Building Enclosure is re-established.
- E. If the Work of any Contractor requires environmental conditions outside temperature ranges identified, then the Contractor requiring such environmental conditions shall provide additional temporary heating, ventilating, cooling and dehumidification as necessary to fulfill required environmental conditions in their specific work areas.
- F. Each appropriate Contractor shall remove any and all soot, smudges, stains, and other deposits and deleterious films, resulting from temporary heating equipment employed by appropriate Contractor, from substrates and finished Work before transition between various Periods of Construction.
- G. Type of equipment and related fuel for temporary heating shall be determined by the HVAC Contractor providing temporary heating, ventilating, cooling or humidity control. Use equipment conforming to requirements by authorities having jurisdiction over the Work; conform to AGA and UL requirements as applicable.
- H. Electrical Contractor shall provide and pay for necessary temporary or permanent electrical items associated with temporary heating, cooling, and ventilating. Relocate as required to complete the Work.
- I. Ventilate enclosed areas to cure materials, to disperse humidity, and to prevent accumulations of dust, fumes, vapors, or gases.
- J. Locate equipment to provide uniform distribution of temporary heating, ventilating, cooling and dehumidification. Vent equipment exhaust to the exterior.
- K. Furnish and maintain on a 24 hour basis as necessary.
- L. Maintain specified conditions for construction operations to protect materials and finishes from damage due to temperature or humidity.
- M. Dehumidification: Contractor responsible for providing temporary heating, ventilating, cooling and dehumidification during Period of Construction shall operate equipment to maintain required minimum and maximum temperatures. The resulting dehumidification will be considered as having satisfied Contractor's responsibility for dehumidification.
 - 1. Any Contractor whose work includes specific humidity or dehumidification requirements, either to perform its work or to protect its work after the work has been performed, shall be responsible for providing separate and additional dehumidification.
 - 2. Such Contractor also shall provide temporary enclosures or partitions as may be necessary to achieve dehumidification.
 - 3. Such Contractor shall maintain dehumidification until permanent HVAC equipment is complete and able to provide the required dehumidification.
- N. Use of Permanent Facilities and Equipment: Permanent Facilities and Equipment may be used for temporary heating, ventilating, cooling and dehumidification.
 - 1. Prior to operation of permanent facilities for temporary purposes, verify that installation is approved for operation, and that filters are in place. Provide and pay for operation,

- maintenance, and routine repair including replacement of filters and worn or consumed parts.
 - 2. Prior to Substantial Completion, for any Permanent Facilities and Equipment used for temporary purposes, replace all filters and belts regardless of condition. Do not use attic stock as a source for replacement filters and belts. Perform all services in accordance with manufacturers' manuals and service orders to place Facilities in like new condition.
 - 3. Owner shall receive extended warranties and guarantees from Contractor as required by these Contract Documents for all Permanent Facilities and Equipment used for temporary purposes. No limitations or conditions shall be applied to such warranties and guarantees as a result of their use for temporary purposes.
- O. Take necessary measures to conserve utility usage by workers at site.
- P. Tie into existing building utilities as required to provide work of this Article. If additional temporary supply utilities are required to provide work of this Article, provide those additional supply utilities as part of base bid requirement.

1.5 TEMPORARY ELECTRICAL SERVICE

- A. Electrical Contractor shall provide, operate, and maintain temporary electrical service required for construction operations. Take necessary measures to conserve electrical usage by all workmen at site.
- 1. Owner shall pay for electrical consumption costs.
 - 2. Electrical Contractor shall pay all other costs associated with providing, maintaining and removing temporary electrical service.
- B. Provide capacity required for building construction and testing.
- C. Provide temporary electrical service within 14 calendar days after written request from any Contractor. Locate near building as determined by Lead Prime Contractor.
- D. Provide aerial service, poles, metering, disconnects, grounding, panelboards, feeder circuits and other electrical equipment as required to provide temporary electrical service.
- E. Provide temporary electrical service branch wiring, separate from lighting, with ground wire and grounding type 120 volt, 20 ampere, ground fault interrupted (GFI/GFCI) duplex convenience outlets located as follows:
- 1. Corridors: maximum spacing 50 feet.
 - 2. Other Spaces: Provide additional duplex convenience outlets as necessary so that all areas of building can be reached with a 50-foot extension cord.
 - 3. Wire maximum of 6 outlets per 20 ampere circuit.
- F. Install temporary wiring in accordance with National Electrical Code, 29 CFR 1926 (OSHA), local electric company, Contractor's insurance company, and local regulations.
- 1. Refer to other Articles in this Section for providing and maintaining additional electrical requirements associated with other temporary utilities.
- G. Maintain temporary electrical service until such time permanent service becomes available; make transition to permanent service.

H. Each Contractor shall provide the following to perform their Work:

1. Electrical service for welding, independent of temporary electrical service provided under this Article.
2. GFI/GFCI protected extension cords.
3. Bear costs for additional temporary electrical service which cannot be provided by the temporary electrical service described in this Article.
4. Repair and refinish of work that is damaged by removal of temporary electrical service.

1.6 TEMPORARY LIGHTING SERVICE

A. Electrical Contractor shall provide, operate, and maintain temporary lighting service required for construction operations. Take necessary measures to conserve electrical usage by all workmen at site.

1. Owner shall pay for electrical consumption costs.
2. Electrical Contractor shall pay all other costs associated with providing, maintaining and removing temporary lighting service.

B. Lighting will be provided by Contractor simultaneous with temporary power as referenced in previous Article of this Section.

C. Provide temporary lighting systems within 14 calendar days after written request from any Contractor.

D. Provide minimum temporary lighting service, including branch wiring and 100 watt lamps and sockets, to provide minimum illumination as required by 29 CFR 1926 (OSHA). In addition, provide temporary lighting service as follows:

1. Corridors: Lights at maximum spacing 30 feet.
2. Spaces Less than 300 sq.ft.: One lamp per space or room.
3. Other Spaces: One lamp for each 300 sq.ft., and one for each remaining fraction.

E. Maintain temporary lighting service in perfect working order throughout construction period. Replace burned out and missing lamps with new materials.

F. Permanent lighting may be used during construction when approved by Construction Manager. Maintain lighting and make routine repairs.

1. All light fixtures used for temporary lighting shall have their lamps and ballasts replaced with new lamps and ballasts immediately prior to Substantial Completion. Attic stock shall not be used for lamp and ballast replacement.

G. Provide temporary exterior site lighting to illuminate areas around field offices, sheds, staging areas, building entrances, and vehicular drive.

H. Install temporary wiring in accordance with National Electrical Code, local electrical company, insurance company, and local regulations.

I. Where existing lighting used for temporary lighting, and then is removed during the progress of construction, provide and maintain required temporary lighting.

J. Each Contractor shall provide the following to perform their work:

1. Bear costs for additional temporary lighting service which cannot be provided by the temporary lighting service described in this Article.
2. Repair and refinish of work that is damaged by removal of temporary lighting service.
3. Provide and maintain temporary electrical and telephone services to offices and sheds.

1.7 FIRE PROTECTION

- A. General Contractor shall provide portable fire extinguishers as required by 29 CFR 1926 (OSHA), or at a rate of one extinguisher per Major Unit and per floor, whichever is greater, during entire construction period. Provide additional extinguishers as they be required by other specification Sections.
 1. Contractor either performing welding, or any work for which 29 CFR 1926 (OSHA) requires a fire extinguisher present in the immediate area of the work, shall provide such fire extinguishers.
- B. Fire Extinguisher: Minimum 20 lb. rating using ABC multipurpose powder with pressure gage.
- C. Make locations of fire extinguisher known to each Contractor and subcontractor who shall inform each worker.
- D. For all fire extinguishers, perform and document inspections of fire extinguishers in accordance with 29 CFR 1926, and requirements of authorities having jurisdiction.
- E. All fire extinguishers shall be "charged" (pressure indicator in the green area of dial) at all times. Any fire extinguisher found not to be "charged" shall be immediately replaced with a "charged" fire extinguisher.

1.8 EXISTING BUILDING SYSTEMS

- A. Contractors in submitting a bid has certified that he has familiarized himself with all existing building conditions and systems encountered. Contractors shall protect and maintain all existing building systems, functions, and utilities during the construction period or until new work replaces aforementioned. Within 30 days from the Notice to Proceed, the electrical, HVAC, plumbing, and fire protection contractors shall complete a full survey of the existing mechanical services and shall confirm, or give notice to the contrary, that all existing panels, equipment, piping services, and conduits are sufficient for the designed use for both temporary and permanent services and are adequate from coordination with the proposed phasing plans.
- B. Existing Systems, Functions, and Utilities: The following is a partial list, which is not all inclusive of the existing Systems, Function, and Utilities: All contractors acknowledge that these existing systems are to be maintained and kept fully operational on a daily basis. Any revisions or taking any system out of operation must be fully coordinated by the Prime Contractor, or its subcontractors, following the established phasing plans and requirements for the interruption of the service as approved in advance by the Owner. All utility disruption requests must be presented at the Weekly Planning Meeting and minimum 24 hours prior to the planned time of disruption. Each contractor that plans to interrupt or adjust any system during construction is responsible to develop and present the temporary alteration plan, which includes advanced work to maintain the required service, to the Owner for approval prior to proceeding. No schedule delay claims will be valid for any contractor that does not fully plan out the interruption and maintenance of any service that presents an incomplete plan leaving the Owner without sufficient time to consider its merits.

1. Existing electrical service including all associated systems and functions
2. Existing water service, domestic and hot water systems
3. Existing sanitary and storm water services
4. Existing HVAC systems, boilers, chillers, and equipment
5. Existing BAS and/or ATC systems
6. Existing lighting systems
7. Existing data, communication, and security systems
8. Existing structural systems
9. Existing fire alarm systems
10. Existing fire sprinkler systems
11. Existing elevator and associated equipment and systems

- C. The use of the existing elevator for construction purposes is limited solely to the time period prior to its refurbishment and upgrade; after which it shall not be permitted for use in construction activities nor circulation by construction personnel. The Owner shall not be responsible for maintaining its proper function during construction activities. The Lead Prime Contractor shall be responsible for maintaining the Elevator if used by any construction personnel, and shall be liable for repairing any damage that might occur from its use during construction.

1.9 MISCELLANEOUS PROVISIONS

- A. Items in this Article apply to other Articles in this Section as they are applicable.
- B. Any Contractor failing to carry out their responsibility in supplying of uninterrupted temporary utilities or services as set forth in this Section, shall be held responsible for such failure. Owner will have right to take such action as deemed proper for the protection and conduct of the work. Costs involved will be deducted from the amount due the Contractor at fault.
- C. Remove temporary utilities when temporary utilities are no longer required by same Contractor responsible for their installation. Restore ground or building disturbed or damaged to proper condition by same Contractor.
- D. Materials used for temporary utilities will be serviceable, new or used, and adequate for required purpose.
- E. Relocate construction aids as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements of Owner, Construction Manager, and other Contractors employed at the site.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 015200 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General administrative and procedural requirements governing temporary facilities and controls including, but not limited to, the following:

1. Temporary Construction Facilities:
 - a. Field offices and sheds.
 - b. First aid.
 - c. Sanitary facilities.
 - d. Construction aids.
 - e. Cranes and hoists.
 - f. Security.
 - g. Project identification.
 - h. Access roads.
 - i. Snow removal.
 - j. Parking.
2. Temporary Controls:
 - a. Barriers.
 - b. Enclosures.
 - c. Building perimeter protection and floor openings protection.
 - d. Surface water control.
 - e. Miscellaneous controls.
 - f. Waste.
 - g. Precautions.
 - h. Protection of Installed Work.

- B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for work associated with each Contract.
2. Section 015100 "Temporary Utilities" for temporary services.

1.2 TEMPORARY STORAGE CONTAINERS

- A. Project Contractors shall construct, furnish, and maintain temporary structures, material containers, and other similar structures required for the performance of their contracts only at locations shown on Drawings or otherwise as directed by Construction Manager.
- B. Coordinate container locations with all Contractors working on site. Relocate temporary storage containers as required to perform the work; move by appropriate Contractor furnishing temporary storage containers, including temporary services. Protect existing surfaces where containers are placed. Contractor will be responsible for any repairs or restoration required to surfaces upon removal of containers.

- C. Each Prime Contractor shall maintain storage containers until completion of their respective scope of work.
- D. Owner shall permit use of interior areas as field offices for each Prime Contractor. Assignment of each space shall be the responsibility of the Lead Prime Contractor.
- E. Lead Prime Contractor shall equip each field office with the following:
 - 1. High-Speed Broadband Internet Service (provide service with best upload and download speed available for Project location). Full internet service shall be fully operational no later than 45 days after establishment of field office and site mobilization. Provide wireless access points and temporary network wiring (minimum 3 RJ-45 connections) to each field office.
 - 2. Power and temporary conditioning to each field office.
- F. Lead Prime Contractor shall provide and furnish a common meeting area with the following:
 - 1. Tables and seating for up to 20 attendees.
 - 2. Dry-erase white board 8'x4' and markers.
 - 3. Bulletin board, 8'x4'
 - 4. Hanger racks for drawing field copies.
 - 5. 65" wall-mounted high-resolution monitor with HDMI input and cord.
 - 6. Webcam, or similar device to provide live video camera feed for video conferencing - must interface with laptop computer, projector, speakerphone, and/or TV monitor for adequate utilization for project meetings.
- G. Each Contractor shall be responsible for upkeep and fit-out of its individual field office. Relocation of field offices may be required as the Work commences. Such relocations shall be at the discretion of the Lead Prime Contractor.
- H. Storage Sheds for Tools, Materials, and Equipment: Weather-tight, with heat and ventilation for products requiring controlled conditions, with adequate space for organized storage and access, and lighting for observation of stored materials.
- I. Accordingly, all Prime Contractors acknowledge that they have included in their bids the onsite budgets designating the assignment of the required project manager and/or super/foreman to the field office. It is required that these Contractors representatives will have the full experience and authority to speak, act, and make decisions on behalf of their company.
- J. It is acknowledged that the Prime Contractors and subcontractors will collaborate and participate in weekly schedule and project planning meetings. These will be scheduled to occur at the same time and day each week. The schedule planning meetings will be focused on defined schedule intervals with task-oriented collaboration for work completion using techniques similar to that of Last Planner ® and Lean Construction, The Primes will plan the work in a make-ready method, using large format dry-erase planning boards, so that tasks can be started and completed without interruption to reach targeted weekly scheduling goals that are in compliance with the Master contract schedule. The Monday meeting will plan to make work ready coordination of the promised work targets.
- K. The Weekly planning meetings will project work for each day of the week and do look-outs for upcoming work activities in two and six week intervals. The Thursday weekly safety meetings will be led by the construction manager for the agenda to include safety topic, weekly scheduled deliveries, planned interruption to the Owner's daily activities, review of RFI's, review of submittals, and discussions on site logistics.

- L. Those Contractors, who fail to meet the terms of the Collaboration requirements, including staffing the office within 15 days of Contract Award, or at a time designated by the Owner, shall be subject to the same penalties for specified failure to appear at progress meetings. If contractor's actual physical start of field work is further down in the schedule or delayed for an extended period of time for any period, through no fault of their own – they may request, through the Construction Manager, that their Colocation attendance be adjusted. However, this does not relieve the Contractor's requirement of full daily attendance while the review of submittals and other relevant coordination work is taking place.

1.3 FIRST AID

- A. General Contractor shall provide and maintain until Acceptance of Final Inspection by Construction Manager a completely equipped First Aid Kit at a central location at Site. Equip first aid station for rendering of minor medical services.
 - 1. First Aid Kit shall be readily available at all times for workmen at Site.
 - 2. Keep in a clean, orderly condition. Restock as items are used.
- B. General Contractor shall designate certain employees, who shall have been properly trained, to be in charge of first aid. At least one such employee shall be available whenever work is being performed.
- C. General Contractor shall post conspicuously a telephone call list for summoning aid from outside sources such as doctors, ambulances, fire department and rescue squads.
- D. Other Contractors may provide their own first aid as part of their safety program, which is the responsibility of each Contractor.

1.4 SANITARY FACILITIES

- A. General Contractor shall provide, maintain and move temporary sanitary facilities for duration of construction period in required quantity. Use of new, permanent and existing fixtures will not be permitted.
- B. Sanitary Facilities: Minimum two (2) enclosed portable self-contained units (porta-john) with toilet paper and hand sanitizer replaced as required. Includes cleaning and waste removal, weekly or more frequent as required by use and condition).
- C. Provide quantity of sanitary facilities as required by 29 CFR 1926 (OSHA).
- D. Coordinate locations with Construction Manager.
- E. Maintain temporary facilities in a neat and sanitary condition.
- F. Do not dispose flammables, solids, or liquids used as part of construction into sanitary facilities.

1.5 CONSTRUCTION AIDS

- A. Each Contractor shall provide construction aids and equipment required to facilitate execution of its work. Construction aids include, but are not limited to: ramps; stairs; scaffolding; ladders; platforms; railings; chutes; hoists; and cranes.

- B. Comply with applicable local, state, and federal regulations for worker safety, public safety and fire protection.
- C. Relocate construction aids as required by progress of construction, work schedule, and to accommodate legitimate requirements of Owner and other Contractors on site.
- D. Where required by the work, provide strong, safe temporary stairs, ladders, scaffolding, etc., for use of workmen and inspectors.
- E. Comply with applicable OSHA, UCC, and Labor and Industry requirements.
- F. Do not use Owner owned equipment and materials to perform contract work.
- G. Provide necessary shoring of excavations by means of shores and braces to avoid cave-ins of excavations until backfilling is completed.

1.6 CRANES AND HOISTS

- A. Each Contractor shall provide hoisting of materials as required for the performance of their work. Certify, inspect, install, operate and dismantle cranes and hoists in accordance with 29 CFR 1926, and safety regulations of authorities having jurisdiction.
- B. Use of cranes and hoists over any occupied building or area, or general public, is prohibited.
- C. Crane and hoist inspections shall be performed as required by Section 011000 "Summary of Work" and 29 CFR 1926 (OSHA).
- D. Crane and hoist operators shall be trained and certified as required by 29 CFR 1926 (OSHA) and authorities having jurisdiction.

1.7 SECURITY

- A. Provide security to protect the Work from unauthorized entry, vandalism, and theft.
- B. Security shall include but not be limited to following: new materials stored and installed; tools, equipment, and field offices and sheds; and other existing or new materials.
- C. Each Contractor and subcontractor shall be responsible for maintaining security of their own work. Any materials or finished Work stolen, damaged, or vandalized shall be repaired or replaced to satisfaction of Construction Manager at no additional cost to Owner by appropriate Contractor and subcontractor.

1.8 PROJECT IDENTIFICATION

- A. Each Prime Contractor shall be entitled to placement of a marking sign not to exceed 16 square feet. Signage may be mounted to construction fencing.
- B. Allow no other signs to be displayed unless approved by Owner or Architect, except those required by law.

1.9 TEMPORARY ACCESS ROADS

- A. General Contractor shall provide and maintain one wheel wash station as needed to limit amount of debris on adjacent roadways. Using temporary water service provided under Section 015100 Temporary Utilities, provide fittings, valves, reducers, hose and nozzle.
 - 1. Each Contractor shall be individually responsible for the removal of dirt and mud from its vehicles from to the vehicles leaving the Site.
 - 2. Construction entrances and wash stations not maintained may be shut down by Owner, Architect or other Authority Having Jurisdiction until appropriate corrective actions are taken to keep debris off public roadways.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. General Contractor shall clean and maintain on-site roads, drives and parking lots to the satisfaction of the Owner and Construction Manager. When notified that on-site roads, drives and parking lots are not being properly cleaned and maintained, General Contractor shall within 24 hours (1 calendar day) perform the necessary cleaning and maintenance.
- D. General Contractor shall clean and maintain adjacent roadways affected by project work to the satisfaction of the Owner and Construction Manager. When notified that adjacent roadways are not being properly cleaned and maintained, General Contractor shall within 24 hours (1 calendar day) perform the necessary cleaning and maintenance.
 - 1. When the cleaning and maintenance of adjacent roadways is governed by any permit condition (for example, NPDES or local earthmoving or building permit), local law or ordinance, or other authority having jurisdiction, General Contractor shall clean and maintain adjacent roads to the satisfaction of such permit, law, ordinance or authority having jurisdiction.
- E. General Contractor shall perform daily street sweeping with a power spray water feature if debris and mud is tracked off site or onto the parking areas and walks.
- F. General Contractor shall perform dust control by watering all site areas if excessive dust is blowing off of the site. Includes the protective screening of masonry mixing station to control airborne dust from spreading to adjacent occupied areas.
- G. General Contractor will install, maintain, and remove/restore for temporary walkways for pedestrian egress around construction site in accordance with the site logistics plan, including any needed handrails, temporary stairs with guard rails. These walkways shall be maintained to prevent mud, rain, and snow from creating safety hazards or tracing of debris into occupied buildings.
- H. Traffic Control: Each Contractor shall provide traffic control barriers and flag persons throughout construction period at any point in time that construction traffic obstructs normal on-site or off-site vehicular or pedestrian traffic conditions
 - 1. Provide flag persons at pedestrian crossings of construction equipment rights of way 100% of the time, when such equipment is operating.
 - 2. Provide and maintain adequate traffic control and flag person's services at points where transporting of equipment and materials engaged on the Work regularly enters and exits from job site.
 - 3. Provide numbers of flag persons necessary for vehicular and pedestrian traffic control.

4. Provide temporary traffic control barriers to ensure safety of persons and property in accordance with applicable regulations.
5. Provide traffic control barriers and/or flag persons at any other location as directed by either the Owner or the Construction Manager to address pedestrian or vehicular safety.
6. Provide as part of each Contract requirement as applicable to their work.

1.10 SNOW AND ICE REMOVAL

- A. General Contractor shall remove snow and ice from buildings, temporary roads and laydown areas, building access walkways, temporary parking areas, and other areas associated with general construction areas to ensure safe access and working conditions. When within the Limits of Disturbance or Limits of Construction, remove snow and ice from existing walks, roads, drives, and parking lots, whether for use by Contractors or Owner.
 1. If applicable, General Contractor shall remove snow and ice from all steps leading to the field offices trailer, walkways from the parking area to the field offices trailer, and the contractor parking area.
- B. Each Contractor: Remove snow and ice accumulations from their excavation areas.

1.11 PARKING

- A. General Contractor shall designate, in conjunction with Owner or Architect, parking areas to be used by Construction personnel.
 1. Parking to be in existing parking areas
 2. Relocate on-site temporary parking areas as required by status of work.
- B. When designated parking areas are not adequate, each Contractor shall provide additional off-site parking.

1.12 BARRIERS AND CONSTRUCTION FENCE

- A. Each Contractor shall provide barriers and/or fencing as required by 29 CFR 1926, law, and authorities having jurisdiction, and as required to warn public of construction areas, and to protect existing facilities and adjacent properties from damage as a result of construction operations.
- B. Contractor or Subcontractor creating an opening, excavation or hazard shall be the entity responsible for providing the barrier.
- C. Erect and maintain all barriers, barricades, lanterns, and fences required by law.
- D. Contractor shall be sole party to determine extent of barriers required to protect the work site, installed materials, and individuals whether they be workmen or general public.
- E. Provide barriers and fences which are structurally stable, neatly constructed, and suitable for purpose intended.
- F. Provide and maintain barriers and barricades required by governing authorities for public rights-of-way.

- G. Provide barriers around existing items designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, and puddling or continuous running water.
- H. General Contractor shall provide and maintain following construction fences as coordinated with Construction Manager:
 - 1. Chain Link Fence: 6 ft. high relocatable type mesh fencing system as shown on Site Logistics Plan.
 - 2. Provide, at a minimum, 2 vehicular gates of adequate size to facilitate construction vehicles and 1 pedestrian gate. See Site Logistics plan.
 - a. Lock each gate using the same master key and provide two (2) to each Contractor and three (3) to the Owner's Agent.
 - b. Each lock shall be paired with an Owner-provided "Knox" padlock for use by emergency personnel. At no time shall gates be locked in such a way that they may not be opened via this padlock.
 - 3. Place NO TRESPASSING signs around the site as directed by Construction Manager.
 - a. Minimum one every 100 feet of fence, and one on each gate.
 - 4. Relocate and provide additional fencing as required for construction access and sequencing.
 - 5. General Contractor shall perform grass mowing and trimming inside site fence and to 1 foot outside of site fence. This applies to grass turf areas that are to remain and are confined within the construction area.

1.13 TEMPORARY ENCLOSURES

- A. At such times as weather circumstances and security requirements warrant as necessary for progress of the work and coordinated with project phasing, General Contractor shall protect interior of each building section or area from entry by unauthorized persons and from inclement weather. Close outside openings either by permanent closure material according to Contract Documents or by temporary weathertight insulated enclosures of material and construction as specifically approved by Architect and Construction Manager.
- B. Remove temporary enclosures from the site when directed by the Construction Manager. Provide as part of each Contract requirement as applicable.
- C. Provide additional temporary enclosures as applicable to perform required work as part of each Contract requirement.

1.14 BUILDING PERIMETER AND FLOOR OPENINGS PROTECTION

- A. General Contractor shall provide and maintain building perimeter protection, which allows for workers to work on elevated decks and surfaces without the requirement of harnesses, lanyards, and similar equipment, in accordance with 29 CFR 1926 (OSHA). Such perimeter protection shall be available for use by all contractors.
 - 1. Roofing Subcontractor shall provide its own building perimeter protection while performing roofing work. No other Contractor will be permitted to perform work on

the roof unless coordinated with the General Contractor, and in compliance with all applicable safety regulations.

- B. When the work of any Contractor requires workers to work on or from areas outside of the building perimeter protection, each such Contractor shall provide harnesses, lanyards, positioning devices, and other equipment as required by 29 CFR 1926 (OSHA).
- C. Each Contractor shall be responsible for securely covering floor and deck openings in accordance with 29 CFR 1926 (OSHA).

1.15 SURFACE WATER CONTROL

- A. Definitions:
 - 1. Dewatering: removal, whether by pumping or other means, of water collecting on the ground surface or in excavations of any type or purpose. This includes both water originating from precipitation, and water originating from underground sources.
- B. Maintain excavations free of water. Provide and operate pumping equipment. Provide dewatering system to keep excavations dry.
- C. Provide as part of each Contract requirement as applicable.
- D. Grade site to drain. For disturbed areas, General Contractor shall grade such areas to avoid the collection of water (puddling) and the flow of water in eroded or graded paths, except as provided for in the Project's approved erosion and sedimentation plan.
- E. General Contractor shall plan and execute construction so as to control surface runoff and drainage and to prevent erosion and sedimentation. Provide temporary measures such as berms, dikes, and drains to prevent water flow. Periodically inspect and make appropriate corrective measures.
 - 1. Other Contractors performing excavation work shall plan and execute their construction so as to control surface runoff and drainage and to prevent erosion and sedimentation. Provide temporary measures such as berms, dikes, and drains to prevent water flow from the area affected by their excavation work. Periodically inspect and make appropriate corrective measures.
- F. Keep roof drains, rain gutters and leaders operational to control roof surface water; do not allow accumulation of water on building roof. Prevent construction materials and debris from entering existing roof drains; temporarily plug roof drains as required, however do not allow ponded water on roof.

1.16 MISCELLANEOUS CONTROLS

- A. Each Contractor shall provide temporary miscellaneous controls as follows: dust control, pollution control, and noise control.
- B. Execute work by methods to minimize raising dust from construction operations. Provide positive means to restrict air-borne dust from dispersing into atmosphere.

- C. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced during construction.
- D. Rodent and Pest Control: General Contractor shall retain a local exterminator or pest control company to minimize attraction and harboring of pests. Employ at regular intervals so that the Project will be free of pests and their residues throughout the project. Perform control operations in a lawful manner using environmentally safe materials.
- E. Noise Control: Fit compressors, generating equipment, and other noise generating equipment with mufflers or other noise abatement attachments.
- F. Supply and maintain a fire extinguisher in temporary rooms, jobsite trailer, at flammable material storage areas, and at all locations where welding or burning occurs.
- G. Drinking Water and Ice: Each Contractor is responsible to provide for their own work forces.

1.17 WASTE

- A. Each Contractor shall collect waste and construction debris from its work areas daily, and deposit waste and construction debris in on-site dumpsters. General Contractor shall provide interior refuse containers on each building floor for collection by all primes. General Contractor to empty interior containers into on-site dumpsters. All dumpsters and interior refuse containers for the use of all prime contractors. Strictly enforce collection and disposal of waste.
- B. General Contractor shall prepare and submit a waste management plan prior to construction activities.
- C. General Contractor shall provide 10-cubic-yard or larger dumpsters for use by all Contractors in quantity required for proper disposal of waste and debris during each stage of project. General Contractor shall be responsible for all costs associated with delivering, hauling and replacing dumpsters for the Contract duration, and shall pay all costs associated with disposing of waste.
 - 1. Do not hold materials more than 7 days during normal weather and 3 days when temperature is expected to rise above 85 degrees.
 - 2. Comply with requirements of NFPA 241 for removal of combustible waste material and debris.
 - 3. Dispose of waste lawfully; submit original manifest to Owner.
- D. Each Contractor shall be responsible for the disposal of its own hazardous, dangerous, and unsanitary waste materials.
- E. Each Contractor shall dismantle crates, crush cardboard boxes, and otherwise attempt to compact its waste so as to minimize its volume.
- F. Recycling: Recycling: The General Prime Contractor is responsible to furnish and manage the recycling dumpsters. Each dumpster shall be labeled for each use by placing a 3 ft. by 4 ft. sign with printed red lettering identifying the contents. 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. The recycling program shall be maintained through all of the project phases until the last area has completed its demo.

1. Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
2. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
3. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
4. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
5. Store components off the ground and protect from the weather.
6. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

1.18 PRECAUTIONS

- A. Each Contractor shall promulgate and enforce rules to prevent following circumstances.
 1. Lighting of open fires upon premises.
 2. Burning of any combustible material on site.
 3. Smoking within project building or within fifty feet of building envelope at any time.
 4. Use of drugs and alcohol anywhere on or near project site.
- B. Each Contractor shall store paints, varnishes, volatile oils, and similar combustible materials in properly labeled storage containers and in storage area as required by law.
- C. Each Contractor shall bring in, handle, use and dispose of gasoline, benzene, other like volatile flammable liquids in accordance with regulations of Fire Underwriters, 29 CFR 1926 (OSHA) and Authorities Having Jurisdiction. Store in properly labeled storage containers.
- D. Follow applicable regulatory hot and safe work procedures when performing welding, cutting, torching, grinding, brazing, or tacking, including protecting personnel and the adjacent work area from fire hazards and obtaining a hot work permit from Construction Manager.

1.19 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

- A. Each Contractor shall remove its temporary facilities and controls prior to Substantial Completion inspection.
- B. Each Contractor shall clean and repair damage caused by installation or use of temporary facilities.
- C. Each Contractor shall remove temporary underground installations completely; grade site as indicated.
- D. Each Contractor shall restore existing facilities used during construction to specified or to original condition.
- E. General Contractor: Restore area under and adjacent to each temporary office and shed after removal from site.

1.20 PROTECTION OF INSTALLED WORK

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Provide temporary and removable protection and maintain protection for installed products. Control traffic and activities in immediate area to minimize damage. Remove protections at appropriate times.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect all finished floors and other surfaces from traffic, dirt, wear, and damage. Protect with RAM Board and properly fasten.
- E. Protect countertops with RAM board, properly fastened.
- F. Protect casework with heavy duty plastic, properly fastened.
- G. Protect any equipment (such as food service) with heavy duty and properly fastened.
- H. Protect any other finish material, equipment, etc. not listed above as required.
- I. Restrict traffic and storage on roof surfaces and lawn areas.
- J. Protect roofing membrane as required during subsequent work during entire construction period.
- K. Each Contractor is responsible for any damage, which may occur to property of any other Contractor connected with the work, to adjacent private or public properties, or to any portion of structure that in any way results from acts of neglect of their employees.
- L. Provide as part of each Contract requirement as applicable. Remove protection of installed work immediately prior to Substantial Completion, or earlier if approved by Construction Manager.
- M. Comply with manufacturer's written instructions for temperature and relative humidity.
- N. Contractors are wholly responsible for protection of predecessor work, both their own and that of others, as may be required to perform subsequent work. Each Contractor is responsible for any damage that may occur to property of other Contractors, or to adjacent private or public properties, or to any portion of the structure that in any way results from acts of neglect by its employees.
- O. Contractors are prohibited from using the refurbished elevator for construction purposes, to include but not limited to, hauling materials, equipment, or personnel between floor levels. If the elevator is found to have been used by the construction personnel, it will be at the Lead Prime Contractor's expense for any repairs, replacements, and inspections required to ensure the elevator finishes, cab, equipment, and controls are in like new condition and properly functioning for all warranty requirements.

PART 2 - PRODUCTS

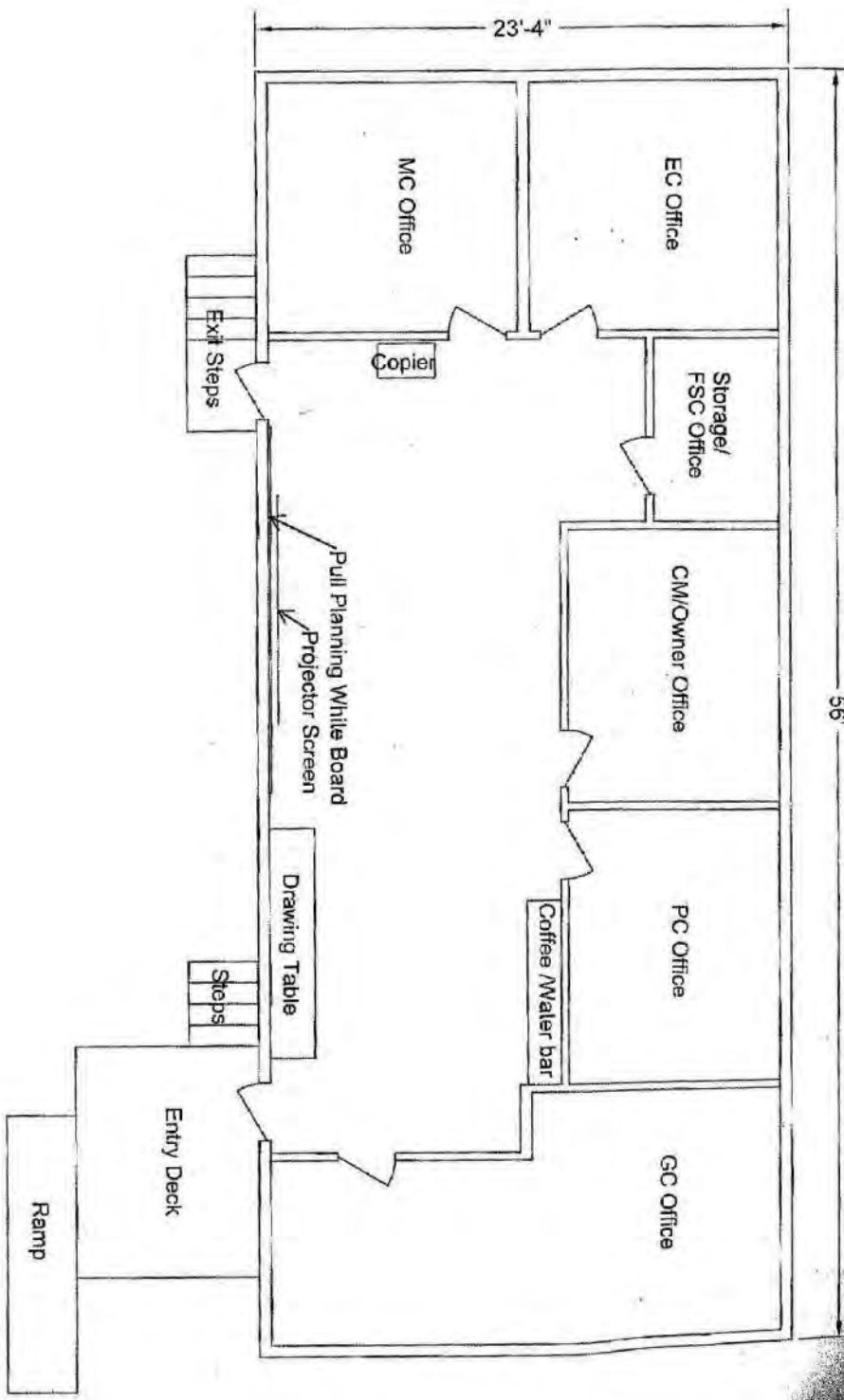
2.1 MATERIALS

- A. General: Each Prime Contractor shall provide new materials. If acceptable to the Owner or Architect, undamaged, previously-used materials in serviceable condition may be used. Provide materials suitable for the use intended.
- B. Lumber and Plywood: Comply with the requirements of Division 06 Section "Rough Carpentry."
 - 1. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sizes and thicknesses indicated.
 - 2. For fences and vision barriers, provide minimum 3/8 inch thick exterior plywood.
- C. For safety barriers and similar uses, provide minimum 5/8 inch drywall on the occupied side of the barrier and 5/8 inch plywood on the construction area side.
- D. Tarpaulins: Provide waterproof, fire-resistant, UL-labelled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins. If used, these are not permitted for temporary enclosures for interior temporary heat.
- E. Open-Mesh Fencing: Provide 0.12 inch thick, galvanized 2 inch chain link fabric fencing, 6 feet in height, with driven galvanized steel pipe posts, 1-1/2 inches I.D. for line posts and top rails and 2-1/2 inches I.D. for corner posts. At Contractor's option, portable fence panels may be utilized, provided that the panels are affixed to feet and secured from blowing over.
 - 1. Refer to Site Logistics Plan for extents of open-mesh fencing.
 - 2. Provide 5'-6" black privacy windscreen made of kitted, HDPE polyethylene. Install windscreen on construction side of fence, using 50-pound break strength tie wraps at 16 inches OC max. Pull fabric taught. Install fabric in locations shown on the Site Logistics Plan. Wind vents are to be provided.
 - 3. Relocate and modify fencing as needed for constructions activities and phasing.
 - 4. Install adequate gates for personnel and material delivery as needed and as indicated on the Site Logistics Plan.
- F. Gypsum Board: Minimum 5/8 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C36.
- G. Insulation: Un-faced mineral-fiber blanket, manufactured from R-19 fiberglass with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- H. Polyethylene Sheet: Reinforced, fire-resistive sheet, 6-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- I. Temporary Rainwater Conductors: PVC piping, fitting, and boots fully connected to storm leaders or other in-place structures sized in accordance with the International Plumbing Code and the International Plumbing Code Commentary.

PART 3 - EXECUTION

Not Used.

END OF SECTION



SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for selection of products for use in Project.
2. Product delivery, storage, and handling.
3. Inspection and maintenance of stored products.
4. Manufacturers' standard warranties on products.
5. Special warranties.
6. Comparable products.
7. Products taken from stock.

B. Related Requirements:

1. Section 011000 "Summary of Work" for Owner related products.
2. Section 012100 "Allowances" for products selected under an allowance.
3. Section 012300 "Alternates" for products selected under an alternate.
4. Section 012500 "Substitution Procedures" for requests for substitutions.
5. Section 017700 "Closeout Procedures" related to submission of executed warranties.
6. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. 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.

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" including make or model number or other designation, to establish 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.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.
- D. "Proposed" Substitutions: Changes in products, materials, equipment and or methods of construction from those required by the Contract Documents, and proposed by Bidder or Contractor. Comply with the requirements as indicated in the Instructions to Bidders.
- E. Proprietary Specifications: Where Specifications name a single product and manufacturer or where the product is accompanied by the words "no substitutions" or where the Specifications otherwise offer no alternative choices, provide the named product that complies with requirements.

1.3 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 demonstrate 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 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 013300 "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 013300 "Submittal Procedures." Show compliance with requirements.
- C. Pre-Bid Substitution Requests: Refer to the Instructions to Bidders for requirements pertaining to pre-bid substitutions.
- D. Post-Bid Substitution Requests: Submit request for consideration identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawings number(s) and title(s).
 - 1. Provision only applies to products that are no longer available or cannot be provided in time to meet the schedule requirements.
 - 2. Substitution Request Form: Use CSI Form 13.1A. Sample included with Specification Section 006300.
 - 3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - b. Statement indicating why specified material or product cannot be provided.

- c. List of similar installations for completed projects with project names and addresses and names and addresses of Architects or Owners.
- d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution. Separate prime contractors shall verify and co-sign the list of changes or modifications or indicate that their Work is not affected.
- e. Cost information, including proposal of change, if any, in the Contract Sum. Include signed statements from separate prime contractors whether or not there are changes to the Contract Sum.
- f. 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 a lack of availability or delays in delivery. Separate prime contractors shall verify and co-sign the changes or modifications to the schedule or indicate that their schedule is not affected.
- g. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
- h. Samples, where applicable or requested.
- i. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
- j. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
- k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
- l. 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.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each Contractor is responsible for providing products and construction methods compatible with products and construction methods of other Contractors.
 - 2. If a dispute arises between Contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Use and incorporate into the Work materials and equipment that:
 - 1. Comply with size, make, type, and quality specified, or as specifically approved in writing by Architect.
 - 2. Conform to applicable specifications and standards.
 - 3. Are designed, fabricated, and assembled in accord with best engineering and shop practices.
 - 4. Are suitable for service conditions.
 - 5. Have interchangeable components of same manufacturer, for similar components.
- C. Do not reuse salvaged materials and equipment removed from existing building, unless directed to in the project drawings or specifications.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Contractor shall be responsible for all costs associated with product delivery, storage, and handling, except as provided for elsewhere in this Section.
- C. 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.
- D. Storage and Staging:
 - 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 UV and sunlight-sensitive materials from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Store cementitious type products and materials on elevated platforms.
 - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 7. Protect stored products from damage and liquids from freezing.
 - 8. Do not allow excessive loads on building structure.
- E. Be responsible for properly located, secure, and weather resistant storage as required by materials. Place materials so as not to obstruct passage on site, within building structures, or in any way which causes impediment or obstruction to other Contractors.

1.6 INSPECTION AND MAINTENANCE OF STORED PRODUCTS

- A. Provide a periodic system of inspection of stored products on scheduled basis to assure that:
 - 1. Environmental conditions are maintained on a continuing basis.
 - 2. For exterior use products only, surfaces of product exposed to elements are not adversely affected and weathering of products, coatings, and finishes is acceptable and subject to requirements of Contract Documents and Construction Manager.
 - 3. State of storage facilities is adequate to provide required conditions.
- B. Comply with manufacturer's instructions regarding schedule and service interval for products and equipment requiring services during long term storage.
- C. Owner and/or Architect reserve the right to perform inspections of stored products.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of Contract Documents.
- 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 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with 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. Where products are accompanied by the term "as selected," Architect will make selection.
 - 4. Where products are accompanied by the term "match sample," Architect will determine whether or not the submitted item matches the sample.
 - 5. Descriptive, performance, and reference standard requirements in 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. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide product by named manufacturer or source that complies with requirements. Comparable products will not be considered.
 - 2. 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.

- 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.
 - 3. 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.
 - 4. Basis-of-Design: Where Specifications name a basis-of-design product, or refer to a basis-of-design product indicated on Drawings, and include a list of manufacturers, provide specified or indicated product or a comparable product by one of other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the basis-of-design product. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of 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 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's colors, patterns, textures", or similar phrase, select a product that complies with requirements; phrase will indicate either "manufacturer's standard range" or "manufacturer's full range." Architect will select color, gloss, pattern, density, or texture from manufacturer's appropriate range for product line as follows:
 - 1. Standard Range: Selections will be made from manufacturer's product line that does not include premium items.
 - 2. Full Range: Selections will be made from manufacturer's product line that includes standard, premium, or custom items.

2.2 PRODUCT SUBSTITUTION

- A. Timing:
 - 1. Proposed Pre-Bid Substitutions: Comply with the requirements as indicated in the Instructions to Bidders.
 - 2. Post-Bid Product Substitutions: Will not be allowed except when, through no fault of the Contractor, a specified product is no longer available. Product substitutions shall be considered "Comparable Products" for the purpose of submitting similar alternative products or materials for Architect's review.

- B. Post-Bid Product Substitution Conditions: Architect will consider Contractor's request for product substitution when post-bid product substitutions are permitted or become necessary and the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests with no action, except to record noncompliance with these requirements.
1. Requested substitution offers Owner substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owners, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.
 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - a. Any claims from other contractors resulting from an approved substitution will be deducted by Change Order from contractor who proposed substitution.

2.3 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 proposed product does not require revisions to Contract Documents, that it is consistent with Contract Documents that it will produce indicated results, and that it is compatible with all other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in Specifications. Significant qualities include attributes such as: performance; weight; size; durability; power/utility service requirements; maintenance and service requirements; visual effect and qualities; 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.
 6. Be responsible for costs for any changes to other Contractors' Work required by, or because of the use of a Comparable Product.
 7. Compatibility with Owner's existing facility system or maintenance standards.
- B. Cost: No increase in Contract Amount will be authorized due to Contractor's request for approval of a comparable product. A decrease in Contract Amount may be required as condition of approval for a comparable product.

2.4 PRODUCTS TAKEN FROM STOCK

- A. It is expected that, with the exception of commodity materials, all products incorporated into this project shall be new, and purchased after the Contract Award specifically for use on this project.
 - 1. Commodity Materials: Items that are generally purchased in bulk, such as copper pipe and electrical conduit. Such items shall be free from deterioration, contamination, mold, mildew, or other defects. Where exposed in finished spaces, they shall have a "like new" appearance, and be free of visual defects.
- B. For any product Contractor intends to take from stock in lieu of purchasing new after Contract Award, Contractor shall clearly indicate that the product is being taken from stock. Products so submitted shall be subject to inspection by the Owner and Architect prior to submittal review.
 - 1. Product may be rejected if it is found, in any manner as determined by the Architect, to not be "like new."
 - 2. Contractor shall provide as part of its submittal receipts indicating when, and from whom, product was purchased. Also include shipping ticket or bill of lading, indicating when product was shipped by manufacturer and received by Contractor.
 - 3. For all products, whether warranty requirements are for a one year term, for manufacturer's standard term which is in excess of one year, or special warranty requirements apply, provide letter from manufacturer listing each product and each product's serial number, and stating that Contract warranty requirements will be honored by manufacturer without qualification.
- C. Products that are accepted by Architect shall be stored in a location that provides appropriate temperature and humidity control; protection against rodents, vermin, insects, and other pests; and against any other means of damage or deterioration.
- D. Products delivered to project site that are found not to be in "like new" condition will be rejected and replaced by Contractor at no additional cost to Owner.
- E. Products taken from stock that do not meet product specifications shall not be accepted as Substitutions.
- F. Products taken from stock that do not meet product specifications shall not be accepted as Comparable Products.

PART 3 - EXECUTION

3.1 PRODUCTS COMMON TO MULTIPLE CONTRACTORS

- A. Products common to more than one Contractor shall be furnished from the same manufacturer, of like models and colors, and otherwise shall provide Owner with uniformity throughout the Work.
- B. Specification Section 083113 "Access Doors and Frames" – All Contractors furnishing Access Doors and Frames shall furnish such from a common manufacturer and model/style/series. Each Contractor shall submit product data for Access Doors and Frames only after reaching agreement with other Contractors that require Access Doors and Frames. Submittals will be reviewed by Architect and Construction Manager only after submittals have been received from all Contractors that require Access Doors and Frames.

1. Access Doors that are required to be key locked shall be furnished with lock cylinders and cores that match the building's other key operated locks. Owner will provide key combination instructions. Unless otherwise directed, Access Doors provided by all Contractors shall be keyed alike.
- C. Specification Section 078413 "Penetration and Joint Firestopping" – All Contractors furnishing penetration and joint firestopping products and systems shall furnish them from a common manufacturer.
 1. Lead Prime Contractor shall furnish a unified product submittal including system diagrams, products and ratings as published by the manufacturer.

END OF SECTION

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner related products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary of Work" for limits on use of Project site and coordination of Owner related products.
 - 2. Section 013300 "Submittal Procedures" for submitting specified items.
 - 3. Section 017700 "Closeout Procedures" for recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction, whether existing construction or new work via this project, necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work of in-place construction, whether existing construction or new work via this project, required to restore construction to either original conditions for existing construction, or Contract requirements for new construction, after installation of other work.
- C. Professional Land Surveyor: Surveyor licensed by the State in which the Project is located.

1.3 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by registered land surveyor certifying that location and elevation of improvements comply with requirements.

- B. Cutting and Patching Plan: Submit plan describing procedures at least 10 working days prior to the time cutting and patching will be performed. Include the following information when structural systems and utilities, including fire protection piping, plumbing, HVAC, electrical, and security systems, are affected:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure, at no additional cost to Owner.
- C. Hazardous Materials Disposal: Dispose of hazardous materials in accordance with all governing laws, regulations, and authorities having jurisdiction. Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 QUALITY ASSURANCE

- A. Professional Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.

- f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.
- 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
- 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. 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.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.5 GENERAL

- A. Build sleeves and anchors into the Work for the proper engagement of the Work.
 - 1. The General Contractor shall build sleeves and anchors into their work for the proper engagement of the work of the other Prime Contractors, provided the sleeves and anchors, along with the installation instructions, are furnished at the proper time. Those that fail to comply with the provision shall do all necessary cutting and patching at their own expense. Coordinate requirements in accordance with Division 1 Section "Project Coordination", and at the required Cutting and Patching Conference.
- B. Coordinate and provide chases, openings, and recesses in new Work to avoid cutting and patching to the greatest extent possible.
 - 1. The General Contractor shall provide chases, openings, and recesses in the new work, as required, provided that the other Prime Contractors furnish the necessary information at the proper time. Those that fail to comply with this provision shall do all necessary cutting and patching at their own expense. Coordinate requirements in accordance with Division 1 Section "Project Coordination", and at the required Cutting and Patching Conference.

- C. Perform all cutting necessary to install Work. Cutting of structural members will not be permitted except by written permission of the Architect.
 - 1. Each Prime Contractor shall do all required cutting and patching of existing construction necessary to install their work. The Prime Contractor, whose work necessitates the need for the cutting and patching, through existing construction, i.e. a duct penetration through existing roof deck shall be the responsible Contractor to perform the cutting and patching, regardless if work of another Prime Contractor is shown in the required opening.
- D. Repair at own expense, all surfaces cut into or damaged as a result of Work.
 - 1. Each Prime Contractor shall repair at their own expense, all existing surfaces cut into, or damaged as a result of their work, where such cutting or damage is beyond the rooms or spaces being altered under the General Contractor's work.
 - 2. All cutting by another Prime Contractor within the rooms or spaces being finished, altered, or renovated by the General Contractor, shall be patched and repaired by the General Contractor at their own expense, except as noted in the following:
 - a. All cutting or existing construction that is unnecessary, excessive, or carelessly done, and cutting of new or existing constructions that is made necessary by ill-timed work or lack of coordination, shall be repaired by the responsible Prime Contractor at their own expense, using skilled mechanics of the proper trades, and to the satisfaction of the Architect.

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 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.
 - 2. When indicated in Contract Documents or with Architect's approval, patch with matching salvaged materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: Existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, the General Contractor shall provide a professional underground utility scan and mark-out of all areas with the site where excavation shall occur. Scan shall verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Verify 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.

3. Before construction, call "Pennsylvania One Call" at 1-800-242-1776.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with installer or applicator present, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where such examination identifies conditions detrimental to performance of the Work, or a written report is required by other Sections, include in the report the following:
 1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- E. If Contractor proceeds with its work on a substrate, whether new or existing, either without performing such examination or without reporting conditions detrimental to performance of the Work, Contractor accepts all responsibility for the performance, durability and acceptance of its Work.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility with a copy to Owner through Construction Manager 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 need for clarification of Contract Documents caused by differing field conditions outside Contractor's control, submit a request for interpretation to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to property survey and existing benchmarks. If discrepancies are discovered, promptly notify Architect.
- B. General: Lead Contractor shall engage a Professional Land Surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- 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 log available for reference by Architect and Owner.
- F. Lead Contractor shall perform field engineering, submittal and recording activities indicated.
- G. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report need to relocate permanent benchmarks or control points to Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on original survey control points.
- H. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.4 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. When directed by Construction Manager, require manufacturer or supplier of a product or service connected to have qualified personnel to provide on-site observations and recommendations at no additional cost to Owner.
 1. Representative shall submit written report to Architect and Construction Manager listing observations and recommendations.
 2. Validate quality of workmanship and materials when required by manufacturer's warranty.
 3. Comply with manufacturer's installation instructions and recommendations, to extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
 4. Provide attachment and connection devices and methods necessary for securing Work as required by manufacturer, even if they are not illustrated in Contract Documents.
- D. Install products at time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- E. 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.
- F. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- G. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- H. 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.
- I. Attachment: Provide blocking, attachment plates, 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 or as required by applicable building codes.
 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.
- J. 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.
- K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
 2. Contractor making a cut is responsible for making required patch.
- B. Temporary Support: Provide temporary support of work to be cut.
- C. 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.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas on Owner's or adjacent properties.
- F. 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

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- entrance of moisture or other foreign matter after cutting, and to prevent leakage from pipe or conduit.
6. Proceed with patching after construction operations requiring cutting are complete.
- G. 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 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. Where patched finishes cannot blend seamlessly into existing finishes, provide neat and even lines between existing finishes and new finishes.
 4. 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 (i.e. – edge to edge of patched surface). Provide additional coats until patch blends with adjacent surfaces.
 5. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
 7. Each contractor is responsible for cutting and patching associated with performance of their Contract work, including all related costs. Provide supports, protection from elements, protection of surroundings, and immediate clean up.
 8. If necessary to remove either existing or newly applied spray-on fireproofing to install subsequent work, Contractor performing subsequent work shall perform patching to comply with original fire-rated assembly rating.
- H. Do not damage or endanger any portion of work installed by other Contractors or property of Owner. Do not alter Owner's or other Contractor's work without written consent of Owner or other Contractor. Make such requests through Architect.
- I. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding. Protect existing construction during cutting and patching to prevent damage. Until provisions have been made to bypass them, take precautions necessary to avoid cutting existing pipe, conduit, or ductwork serving building, but scheduled to be removed or relocated.
- J. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 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.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 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 according to Section 015200 "Temporary Facilities and Controls".
- B. Each Prime Contractor shall be responsible for its own cleanup and their portion of debris for daily general cleanup.
- C. General Contractor to provide one laborer for daily general cleanup throughout project including but not limited removal of debris from designated trash containers and sweeping of areas.
- D. Lead Prime Contractors shall schedule regular site clean ups for which all prime contractors will be required to provide at least one individual to participate in.
- E. Site: Maintain Project site free of waste materials and debris.
- F. 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.

- G. 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.
- H. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- I. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- J. 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 015200 "Temporary Facilities and Controls."
- K. 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.
- L. Clean and provide maintenance on completed construction as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- M. Limiting Exposures: Supervise construction operations to assure that no part of construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements by related systems and in Section 019113 "General Commissioning Requirements." Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation comply with qualification requirements in Section 014000 "Quality Requirements."

END OF SECTION

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Division 01 Section "Modification and Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 - 2.
 - 3. Section 017300 "Execution" for progress cleaning of Project site.
 - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 5. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 6. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.
 - 7. Individual Construction Specification Sections for specific closeout and special cleaning requirements for products of those Sections.

1.2 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.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction, including but not limited to following:
 - 1. Certificate of Occupancy/General Building Inspection.
 - 2. Certificates of Rough-In and Final Inspections:
 - a. Plumbing.
 - b. Mechanical.
 - c. Electrical.
 - d. Fire Protection.
 - e. Fire Marshall.

- f. Department of Labor and Industry.
 - g. Others as applicable to the Work and jurisdiction.
 - 3. Certificate of Insurance: For continuing coverage.
 - 4. Payment Certifications:
 - a. Contractor's Affidavit of Payment and Debts and Claims (AIA Form G706): To requirements of General and Supplementary Conditions.
 - b. Consent of Surety Company to Final Payment (AIA Form G707).
 - c. Final Contractors or Subcontractors Weekly Payroll Certifications for Public Works Projects (Pennsylvania Department of Labor and Industry, L&I Form 128, Rev-588).
- B. Final Adjustment of Account:
 - 1. Submit a final statement of accounting to Architect reflecting adjustments to Contract Sum:
 - a. Original Contract Sum.
 - b. Contract Modifications resulting from:
 - 1) Previous Charge Orders.
 - 2) Unit Prices.
 - 3) Deductions for uncorrected work.
 - 4) Deductions for liquidated damages.
 - 5) Deductions for re-inspection payments.
 - c. Total Contract Sum, as adjusted.
 - d. Previous Payments.
 - e. Sum remaining due.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL, SPARE PARTS AND SPECIAL TOOLS SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.
 - 1. List maintenance materials by Section number and maintenance material name, including but not limited to: spare parts; replacement parts; attic stock/extra materials; special tools; and other items, as specified in other Sections.
 - 2. Identify quantities of each item to be submitted.
 - 3. Submit Schedule no less than 30 days prior to requesting inspection for determining date of Substantial Completion.

1.5 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 value, and value plus 50 percent, of each item on list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete 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 this Section and in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number where applicable.
 5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete interior and exterior final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Contractor's 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 Substantial Completion inspection. Inspect the Work and include with written request a written list of items not complete to Architect through Construction Manager. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements.
- E. Architect's Inspection: Architect will prepare 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. Authorized, responsible representatives of Contractor requesting inspection shall accompany the Architect during the entirety of inspection. These representatives shall

- consist of Contractor's On-Site Superintendent and Project Manager. Either or both have full authority to make decisions on behalf of Contractor.
2. Owner will be invited, but not required to attend the inspections.
 3. Re-inspection: If Architect determines, after Architect's Inspection, that the Work is not Substantially Complete, a re-inspection by Architect will be required before Architect can establish that the Work is Substantially Complete. Request re-inspection when all Work identified in previous inspections, necessary for Substantial Completion, as incomplete has been completed or corrected.
 4. Results of completed inspection will form basis of requirements for final completion.
 5. Architect will only perform one re-inspection to establish Substantial Completion. If more than one re-inspection is required to establish Substantial Completion, Contractor shall reimburse all labor cost and expenses for Architect personnel involved in each additional re-inspection to Architect by Prime Contractor Change Order. Labor costs shall include wages, taxes, benefits, and other burden paid by Architect, plus travel expenses.

1.6 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 012900 "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.
 5. Submit all close out documentation – hard copies and digital copy per specification requirements.
- B. Contractor's 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.
- C. Architect's Inspection: 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: If Architect determines, after Architect's Inspection, that the Work is not Complete, a re-inspection by Architect will be required before Architect can establish that the Work is Complete. Request reinspection when all Work identified in previous inspections as incomplete has been completed or corrected.
 2. The Architect and Construction Manager will only perform one re-inspection to establish Completion. If more than one re-inspection is required to establish Completion, Contractor shall reimburse all labor cost and expenses for Architect personnel involved in each additional re-inspection to Architect and Construction Manager by Prime Contractor Change Order. Labor costs shall include wages, taxes, benefits, and other burden paid by Architect or Construction Manager, plus travel expenses.

1.7 CONTRACTOR'S 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.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. Submit list electronically via Architect's document management platform.
- B. All prime contractors shall complete all punch-out work within 30 calendar days of the publication of their final respective punch lists, unless there is a verified lack of material or equipment to complete the corrective work. Shortage of labor is not an exception. Should the contractor fail to complete the punch out work within the designated time, the Owner will reduce the final retention payment by \$750 for each calendar day that the Contractor exceeds that day as verified by the Architect.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on 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 product or installation. Provide a typed description of product or installation, including product name and name, address, and telephone number of Installer.
 - 3. Identify each binder on front and spine with 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.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals as submitted under provisions of Section 017823 "Operation and Maintenance Data".

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: General Contractor shall 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 according to appropriate Contract work scope:
 - 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, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Wipe exposed duct work and pipe, whether in occupied spaces or not, to remove dust, dirt, mortar droppings, and other debris.

- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure and use.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated during construction or that display contamination with particulate matter on inspection.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - r. Leave Project clean and ready for occupancy.
 - s. Clean, buff, wax or otherwise finish flooring as required in other Sections.
- C. Comply with safety standards for cleaning: do not burn waste materials; do not bury debris or excess materials on Owner's property, and do not discharge volatile, harmful, or dangerous materials into drainage systems.
- D. Pest Control: Comply with pest control requirements in Section 015200 "Temporary Facilities and Controls." Prepare written report.
- E. Construction Waste Disposal: Remove waste materials from Project site and dispose of lawfully. Comply with requirements in Section 015200 "Temporary Facilities and Controls"

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 bulbs that are burned-out at time of or prior to Substantial Completion. In addition, replace all bulbs used for temporary lighting, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 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 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 3. 017700 "Closeout Procedures" for timing of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

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

1.3 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at 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. 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.

- C. Initial Manual Submittal: Submit electronic draft copy of each manual no more than 30 days after substantial completion. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each electronic manual in final form prior to requesting inspection for Substantial Completion and at least 30 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 hard copies of each corrected manual within 15 days of receipt of Architect's comments.
 - a. Two (2) hard copies of O&M manuals to be provided to Owner.
 - b. One (1) digital copy of O&M manuals on USB flash drive to be provided to Owner.
 - c. Final PDF copy of O&M manuals to be provided to Architect.
 - 2. All prime contractors shall fully complete all tasks relative to their submission responsibilities under the close-out documentation to include but not be limited to submission of all warranties, as-built drawings, final test and certified balance reports, factory start-ups of equipment, owner on site operational and care instructions on all major equipment and systems, operation and maintenance manuals. Should the contractor fail to complete any of their close-out responsibilities within 60 days of the Substantial Completion date, the owner will reduce their final retention payment by \$750 for each day that the contractor exceeds that day - as verified by the Architect.

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 Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. 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, or other original electronic files, where available. Minimize scanning of paper documents. 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.

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 to be followed in event of each following emergency. Purpose is to minimize damage to system, subsystem or piece of equipment by preparing it for emergency.
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.
 6. Inspections to be performed prior to restarting or operating, including inspections necessary to maintain warranties.
 7. Monitoring to be performed during restarting and initial operations.

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.
 11. Contact information for Contractor's manufacturer-approved local/regional warranty service and repair company.
- 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 operation sequence 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 and their components.
- 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.
 - 1. Contact information for Contractor's manufacturer-approved local/regional warranty service and repair company.
- 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 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.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Where required as part of submittal packages include copies maintenance agreements with name and telephone number of service agent. This shall include sample maintenance agreement submittals.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow, including contact information, and required notifications for warranty claims.
- I. Diagnostics and service tools: Where required in the specifications, provide license-free copies of all necessary diagnostic software and service tools.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate 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.
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Final versions of all Architect-reviewed record submittals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating project record documents covering the Work of multiple contracts.
 - 2. Section 017300 "Execution" for final property survey.
 - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 5. Section 017900 "Demonstration and Training" for manufacturer's instruction for the care, maintenance, and repair of products, materials, and finishes.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Each Prime Contractor to submit one-set of marked-up record prints and one annotated PDF electronic set.
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one set of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal
 - 1) Submit pdf electronic files of scanned record prints and one set of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project Specifications, including addenda and contract modifications.
- C. Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and 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 Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations 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, including RFI's and supplemental instructions.
 - 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 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.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: PDF electronic file. Scan marked-up hardcopies to PDF or annotated PDF files are acceptable.

2. Incorporate changes and additional information previously marked on record prints. Refer instances of uncertainty to Architect through Construction Manager for resolution.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither original Contract Drawings nor Shop Drawings are suitable to show actual installation. A Change Order will be issued to create newly prepared record drawings.
 1. New Drawings may be required when a Change Order is issued or as a result of accepting a Contract modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Project Record Drawings: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Paper Record Drawings: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets. Identification as follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.
 2. Digital Record Drawings: Annotated PDF electronic file with comment function enabled. Organize digital data information into separate digital files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

2.2 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file and paper copy.
 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. Following are examples of miscellaneous record submittals; revise to relate project specific work scopes.
 - 1. Foundation depths.
 - 2. Special measurements.
 - 3. Tests and inspections.
 - 4. Surveys.
 - 5. Mix records.
 - 6. Inspections by authorities having jurisdiction.
- C. Format: Submit miscellaneous record submittals as PDF electronic file and paper copy.
 - 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 field office apart from Contract Documents used for construction. Do not use the 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

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

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.
- B. Qualification Data: for Facilitator & Instructor.

1.3 QUALITY ASSURANCE

- A. Instructor Qualifications: Factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Pre-Instruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Agenda will include a discussion of the following:
 - 1. Review items of Work that require demonstration and training.
 - 2. Review instructional procedures, including videography requirements.
 - 3. Inspect and discuss locations and other facilities required for instruction.
 - 4. Identify who will be instructed, and their availability.
 - 5. Establish instruction schedule.
 - 6. Review and verify availability of instructional materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 7. Review required content of instruction.
 - 8. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 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. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish names and positions of participants.
 - 2. Construction Manager will coordinate between Owner and Contractor for number of participants, instruction times, and locations.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner through Construction Manager with at least seven days' advance notice.
 - 2. One training session to be provided for each type of system, subsystem or equipment used on Project.
- C. Training Location and Reference Material: Conduct training on-site in completed and fully operational facility using actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 011200 "Multiple Contract Summary" for Prime Contract delineation of work and coordination requirements.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.

1.2 DEFINITIONS

- A. Remove:** Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage:** Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall:** Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain:** Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle:** To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.**
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.**
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:
 - a. Owner shall demolish existing monument sign before or during construction.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
 1. No known warranties in effect.
 2. General Contractor shall be responsible for ensuring existing asphalt roof (circa 2015) remains intact and leak free following performance of its work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. If applicable, inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least 3 hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

- A. Remove and Salvage:
1. Electrical Contractor to disconnect and remove existing generator, transfer switch and disconnect.
- B. Remove and Reinstall:
1. Subject to maintaining site and building security, Prime Contractors may temporarily remove existing construction elements for the purpose of new construction. Such elements shall be stored safely and reinstalled to same location from which they were removed in good condition and proper working order.
 - a. Contractors shall document with photos and/or video the in-situ condition of such items prior to removal.

END OF SECTION 024119

SECTION 024850

GRADING AND SEEDING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work in this section includes, but is not limited to:
 - 1. Stripping and stockpiling topsoil.
 - 2. Placing existing and new topsoil.
 - 3. Seeding and fertilizing.
 - 4. Maintaining seeded areas until acceptance.
- B. Related work specified elsewhere
 - 1. Contractor is responsible to review Contract Documents to coordinate the work for this section with the requirements of all associated sections.
- C. Restore unpaved surfaces to a condition similar to or better than that prior to construction activities.
- D. Reference to PennDOT Specifications shall mean the latest revision of the publication.

1.02 DELIVERY, STORAGE AND HANDLING

- A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging. Damaged or open packages are not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer. Damaged or open packages are not acceptable.

1.03 EXISTING CONDITIONS

- A. Beginning work means acceptance of existing conditions.

PART 2 – PRODUCTS

2.01 SOIL SUPPLEMENTS

- A. Pulverized Agricultural Limestone
 - 1. Pulverized Agricultural Limestone shall be supplied in accordance with PennDOT Specifications Publication No. 408, Section 804.2(a).1.

B. Fertilizer

1. Fertilizer shall be supplied in accordance with PennDOT Specifications Publication No. 408, Sections 804.2(a).2 and 804.2(a).3.

C. A shop drawing shall be submitted for each supplement used.

2.02 SEED

A. Seed shall be supplied in accordance with Section 804.2.(b) PennDOT Specifications Publication No. 408.

B. A shop drawing shall be submitted for each seed used.

C. Seed formulas, rates, seeding dates and seeding locations shall be as set forth in Table 1.

2.03 HERBICIDES

A. Herbicides shall be in accordance with Section 804.2.(d) of PennDOT Specifications Publication No. 408.

B. A shop drawing shall be submitted for each herbicide used.

2.04 EXISTING TOPSOIL

A. Existing topsoil shall be stripped and stockpiled in accordance with Section 801 of PennDOT Specifications Publication No. 408, and in conformance with all rules and regulations at the local conservation district having jurisdiction.

2.05 NEW TOPSOIL

A. Having a pH of between 6.0 and 7.0; containing not less than 2% nor more than 10% organic matter as determined by AASHTO T194.

B. New topsoil shall comply with Section 802.2 of PennDOT Specifications, Publication No. 408.

C. Topsoil shall be provided from an approved outside source and shall be accompanied by a grading analysis report showing the minimum percent passing through the specified sieve screens and the minimum and maximum percent of sand, silt and clay material passing the No. 10 sieve.

D. A shop drawing shall be submitted for new topsoil.

2.06 MULCHING MATERIALS

- A. Mulches for seeded materials shall be in accordance with Section 805.2(a).1 of PennDOT Specifications, Publication No. 408.
- B. Mulches for planting and other areas shall be in accordance with Section 805.2(a).2 of PennDOT Specifications, Publication No. 408.
- C. Mulch binders shall be in accordance with Section 805 of PennDOT Specifications, Publication No. 408.
- D. A shop drawing shall be submitted for each mulch used.

2.07 SLOPE EROSION PROTECTION AND SWALE PROTECTION

- A. Protection Materials shall be in accordance with Section 806 of PennDOT Specifications, Publication No. 408.
- B. Type supplied, unless otherwise noted on the plans, shall be Geojute/Anti-wash as manufactured by Belton Industries of Atlanta, GA, or equal.
- C. Contractor shall submit a shop drawing for each type of Protection Material being used. Additionally, Contractor shall include all runoff calculations used to design the slope protection. No slope protection shall be installed until Contractor receives acceptance from the Engineer in writing specifically identifying the area and material to be used.

2.08 PLANTS, PLANTING, AND TRANSPLANTING

- A. Plants and plantings shall be in accordance with Section 808 of PennDOT Specifications, Publication No. 408, and the most current edition of the "American Standard for Nursery Stock".
- B. Species and size shall be the same as damaged or removed by the Contractor unless otherwise directed by the Owner in writing.
- C. Contractor shall submit a shop drawing for each type of plant or planting supplied. Shop drawing should list age, size, species and nursery supplying planting, along with specific locations of planting. No planting shall be ordered until Contractor receives acceptance from the Engineer in writing.
- D. Wetland plants shall be acclimated for growth in saturated soil conditions. Plantings shall be purchased from a registered wetland nursery.

2.09 SELECTIVE TREE REMOVAL AND TRIMMING

- A. Stump or basal treatment herbicide shall be in accordance with Section 810.2 of PennDOT Specifications, Publication No. 408.
- B. Contractor shall not remove or trim any tree or bush unless directed by the Owner in writing.

2.10 TEMPORARY PROTECTIVE FENCING

- A. Fencing shall conform to Section 811 of PennDOT Specifications, Publication No. 408.
- B. Fencing shall be placed as indicated or directed by the Engineer or Engineer's representative in the field.
- C. A shop drawing shall be submitted for all fencing used.

2.11 GEOTEXTILES

- A. Geotextile material shall conform to Section 212 and Section 735 of PennDOT Specifications, Publication No. 408.
- B. A shop drawing shall be submitted for each geotextile fabric used.

2.12 ROCK LINING

- A. Rock material shall conform to Section 850 of PennDOT Specifications, Publication No. 408.
- B. All rock supplied shall be accompanied by a certification, from the supply quarry, as to the gradation and class of the rock supplied. No rock shall be delivered to site until Contractor receives acceptance from the Engineer in writing.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Protect existing underground improvements from damage.
- B. Remove foreign materials, plants, roots, stones, and debris from site. Do not bury foreign material.
- C. Existing topsoil should be stripped and stockpiled.

3.02 TIME OF OPERATIONS

A. Spring Seeding:

1. Preliminary operations for seed bed preparation may commence as soon after March 1 as ground conditions permit, but shall end by May 30.

B. Fall Seeding:

1. Preliminary operations for seed bed preparation may commence after July 30, but shall end by October 1.

C. All Other Period

1. If construction is completed at times of the year other than noted above, temporary cover work shall be performed to provide interim soil coverage. The temporary cover work shall be followed by a second seeding in accordance with the attached Table 1 during the above noted time periods.

3.03 PLACING OF SOIL SUPPLEMENTS

A. Place soil supplements in accordance with Section 804 of PennDOT Specifications, Publication No. 408, and as follows:

1. Uniformly apply supplements to the areas to be seeded, except areas to be seeded with Formula E, as identified in the attached Table 1.
2. On topsoiled areas, blend the initial soil supplements into the soil at least 2" by disking or harrowing or by another acceptable method approved by the Engineer in writing. The blending of the supplements may be performed during tillage operations.
3. Prior to project completion, apply slow-release, nitrogen fertilizer to the surface of Formula B, D, L and W seeded areas.
4. Apply soil supplements as follows:

Pulverized Agricultural Limestone @ 800 lbs/1,000 sy

10-20-20 Analysis Commercial Fertilizer @ 140 lbs/1,000 sy

38-0-0 Ureaform Fertilizer @ 50 lbs/1,000 sy

or

32-0-0 to 38-0-0 Sulta Coated @ 50to59lbs/1,000 sy

Urea Fertilizer (as per Mfg. or recommended)

31-0-0 IBUDU Fertilizer @ 60 lbs/1,000 sy

3.04 TILLAGE

- A. Perform tillage on topsoiled areas in accordance with Section 804 of PennDOT Specifications, Publication No. 408, and as follows:
1. Correct surface irregularities by filling any depressions and leveling rough or uneven areas. Remove all metal objects, stones larger than 2 inches and any other debris detrimental to restoration operations.
 2. Topsoil areas 3:1 and flatter thoroughly loosen the surface to a depth of not less than 6 inches by utilizing a Tuflite TW5 Series Tandem Disc Harrow, or equal and compact utilizing a P10 Series Single Gauge Pulverizer (Culti-Packer) as manufactured by Brillion Mfg., or equal.

3.05 SEED APPLICATION

- A. Apply seed in accordance with Section 804.3(a) of PennDOT Specifications, Publication No. 408, and as follows:
1. Spread seeds at the rates specified in the attached Table 1.
 2. Sow seeds uniformly on the prepared areas by the helicopter, hydraulic placement, broadcasting, drilling or hand seeding wetlands in accordance with manufacturer's recommendations.
 3. Spread seeds within the following dates:

-	Formula B, D & L	March 15 to June 1 August 1 to October 15
-	Formula C	Ryegrass Portion; March 1 to October 15 Crownvetch Portion; Anytime except September and October
 4. Upon completion of sowing, cover seed to an average depth of 1/4 inch by hand raking or approved mechanical methods.
 5. On topsoiled areas, where temporary seeding or mulching has been applied, use tillage and soil supplements prior to permanent seeding.

6. On untopsoiled areas, where temporary seeding or mulching has been applied, permanent seed and/or soil supplements may be applied without tilling.
7. After seeding, roll topsoiled areas with a roller, weighing not more than 65 lbs. per foot width, or through the utilization of a Culti-Packer attachment or by another method approved by the Engineer in writing.
8. Seeded area shall be watered with a fine spray in such a manner as not to wash out the seed area. Seeding operations shall be done on a still day.
9. Maintain grass areas within grading limits until the area has been accepted by the Owner. Mow as needed or directed. Control prohibited and noxious weed growth within the restored area.

3.06 HYDROSEEDING

- A. Mix specified seed, fertilizer, and fiber mulch in water using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application
 1. Mix slurry with non-asphaltic tackifier.
 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate.

3.07 APPLICATION OF HERBICIDES

- A. Apply herbicides in accordance with Section 804.3(h) of PennDOT Specifications, Publication No. 408, and as follows:
 1. Apply herbicides where weed growth is prominent. Application shall be by personnel certified by the Department of Agriculture and with equipment specifically designed for the spread of herbicides.
 3. No herbicides shall be utilized in wetland areas.

3.08 EXISTING TOPSOIL

- A. Stripping and Stockpiling
 1. Strip and stockpile existing topsoil in accordance with Section 801.3 of PennDOT Specifications, Publication No. 408, and as follows:
 - a. After clearing operations have been completed and prior to any other work activities, remove topsoil from area of construction operations and stockpile.

- b. Provide soil erosion controls as indicated on the plans. Seed stockpiled topsoil in accordance with the County Conservation District requirements.

B. Placing Stockpiled Topsoil

1. Place stockpiled topsoil in accordance with Section 803 of PennDOT Specifications Publication No. 408, and as follows:
 - a. Remove topsoil from stockpiles using an acceptable method which does not mix topsoil with foreign materials.
 - b. After placing topsoil, provide tillage and soil supplements prior to commencing any seeding operations.

3.09 PLACING NEW TOPSOIL

- A. Topsoil shall be placed in accordance with Section 802.3 of PennDOT Specifications, Publication No. 408, and as follows:
 1. Grade the areas to be covered with topsoil. Loosen soil to a depth of not less than 6" before placing the topsoil. Remove stones 2 inches or larger and dispose of unsuitable and surplus material.
 2. Place topsoil on the prepared areas to the required depth.
 3. Compact with a roller weighing not over 120 lbs. per foot of width or to other acceptable methods.
 4. Provide tillage and soil supplements to the new topsoil prior to commencing any seeding operations.

3.10 PLACEMENT OF MULCH

- A. Place mulch in accordance with Section 805.3 of PennDOT Specifications, Publication No. 408, and as follows:
 1. Mulching seeded areas.
 - a. Place mulch immediately after seeding or within 48 hours of seeding completion. Place only straw or wood cellulose over topsoiled areas.
 - b. Place straw or hay uniformly, in a continuous blanket, at a rate of 1,200 lbs per 1,000 square yards. Anchor straw or hay with acceptable materials at the following rates:

- Emulsified Asphalt, not less than 31 gallons per 1,000 sy.
 - Wood Cellulose, 160 lbs per 1,000 sy.
 - Chemical mulch binders or a light covering of topsoil may be used for anchorage when the size of the area precludes the use of mechanical equipment.
- c. Apply wood cellulose fiber hydraulically at a rate of 320 pounds per 1,000 square yards.
1. Incorporate as an integral part of the slurry after seed and soil supplements have been thoroughly mixed.
- d. When mulch is applied to grass by blowing equipment, the use of cutters in the equipment will be permitted to the extent that a minimum of 95% of the mulch is 6" or more in length.
2. Mulching Planted Areas
- a. Place mulch in accordance with Section 805.3(b) of PennDOT Specifications, Publication No. 408, and as follows:
- 1. Uniformly mulch entire plant pit basins, and shrub beds to a depth of not less than 3 inches. Do not mulch areas planted with Crownvetch.
 - 2. Place mulch by hand or with mechanical spreading equipment manufactured for this purpose.
 - 3. Apply mulch within 48 hours after completion of each planting area.
 - 4. Maintain mulched area until the entire project has been completed. Reapply mulch that has become dislodged as directed by Engineer.

3.10 PLACEMENT OF EROSION PROTECTION

- A. Placement of erosion protection materials shall be in accordance with Section 806.3 of PennDOT Specifications, Publication No. 408, and as follows:
- 1. Place erosion control materials after the slope or swale has been dressed.
 - 2. Place erosion control materials to conform to the shape of the soil surface.

3. Spread out materials evenly and smoothly.
4. Unroll materials parallel to the flow direction.
5. Drive all staples flush with the soil surface.
6. Install upslope ends and overlap edges per the manufacturer's recommendations.

3.11 PLANTS, PLANTING & TRANSPLANTING

- A. Plants, planting and transplanting shall be performed in accordance with Section 808.3 of PennDOT Specifications, Publication No. 408, and as follows:
 1. Planting shall occur according to the following:
 - a. Deciduous Trees and Shrubs: October 15 to May 15
 - b. Evergreen Trees and Crownvetch Plants: March 1 to May 15 and August 1 to September 15
 - c. Seedlings and Seeding Transplants: March 1 to May 15
 - d. Rhizomes, Bulbs and Tubers: March 1 to May 15
 - e. Plugs and Peat Pots: March 1 to September 15

3.12 SELECTIVE TREE REMOVAL & TRIMMING

- A. Tree removal and trimming shall be in accordance with Section 810.3 of PennDOT Specifications, Publication No. 408, and as follows:
 1. Contractor shall not burn any debris onsite unless approval has been granted by the Owner.
 2. Fall trees in a manner that will avoid damage to trees, shrubs and other installations which are to be retained.
 3. Trees in construction zones or rights-of-way shall not be removed until inspected and/or tagged by the Owner.
 - A. No trees shall be removed within the construction zone or rights-of-way except the following:
 - a. Trees within an excavated area such as footing or trench.
 - b. Trees whose root system will be destroyed by the excavation.
 - c. Trees that interfere with the movement of the Contractor's equipment with the approval of the Owner. Any trees that

interfere with the movement of the Contractor's equipment shall be reviewed by the Owner before they are removed.

4. All trees bordering any construction zone or right-of-way shall be protected by acceptable methods. (Trees damaged by the Contractor will be either repaired or replaced as determined by the Owner at the Contractor's expense).
5. Stumps
 - A. Stumps required to be removed shall be to a depth of 18 inches. This depth shall be measured from the existing ground surface or the proposed finished grade, whichever is the lower. All stumps in lawn areas shall be removed.
 - B. Engineering requirements shall control removal of stumps under fills, foundations, or any construction in contact with the stumps.
6. When required, with the Owner's approval, trees shall be trimmed to remove branches or roots which interfere with construction or traffic. Paint all cut branches and roots with a coating as recommended for this application.
7. Material which is to be salvaged, as a result of the clearing operations, shall include the following items which are to be turned over to the property owner, if the property owner so desires.
 - A. Logs over 12 inches, butt diameter
 - B. Branches over 6 inches, butt diameter
 - C. Parts suitable for use as a mulch
 - D. Live parts suitable for replanting
8. All salvageable material not desired by the property owner shall be removed as part of the Work. Cut logs and branches into cordwood, 2 feet 6 inches in length and store on site where acceptable to the Owner.

3.13 INSTALLATION OF PROTECTIVE FENCING

- A. Protective fencing shall be installed in accordance with Section 811 of PennDOT Specifications, Publication No. 408.

3.14 INSTALLATION OF GEOTEXTILES

- A. Geotextile shall be installed in accordance with Section 212 of PennDOT Specifications, Publication No. 408, and as per the manufacturer's recommendations.

3.15 SPECIFIC AREAS OF RESTORATION

A. Final Restoration of Lawn and Park Areas

1. After installation of proposed improvements, prepare subbase by tilling a minimum of 2" in depth.
2. Removal all debris and rock in excess of 2" in any direction.
3. Place Topsoil on prepared area, spread and compact to a 6" uniform depth.
4. Compact with a roller weighing not over 120 lbs. per foot of width.
5. Provide tillage and soil supplements to the new topsoil prior to commencing any seeding operations.
6. Apply seed (Formula "B") or sod at the recommended rates within the recommended seeding dates.
7. Upon completion of sowing, cover seed to an average depth of 1/4" by hand raking or approved mechanical method.
8. Water as needed.
9. Place mulch immediately after seeding or within 48 hours of seeding completion. Place only straw or wood cellulose at the recommended rates.
10. Maintain restored areas within grading limits until the entire project is accepted.

B. Final Restoration of Open Field Areas

1. After installation of proposed improvements, prepare subbase by tilling a minimum of 2" in depth.
2. Removal all debris and rock in excess of 2" in any direction.
3. Place topsoil on prepared area, spread and compact to a 6" uniform depth.
4. Compact with a roller weighing not over 120 lbs. per foot of width.

5. Provide tillage and soil supplements to the new topsoil prior to commencing any seeding operations.
6. Apply seed (Formula "W") at the recommended rates within the recommended seeding dates.
7. Upon completion of sowing, cover seed to an average depth of 1/4" by hand raking or approved mechanical method.
8. Water as needed.
9. Place mulch immediately after seeding or within 48 hours of seeding completion. Place only straw or wood cellulose at the recommended rates.
10. Maintain restored areas within grading limits until the entire project is accepted.

END OF SECTION 024850

TABLE 1
GRADING AND SEEDING

Formula and Species	Percent by Weight		Seeding Rates in lbs./ 1000 sq. yd.	Recommended Seeding Dates	Recommended Planting Location
B Perennial Ryegrass Creeping Red Fescue or Chewings Fescue Kentucky Bluegrass	20% 30% 50 %	TOTAL	4 LB. 6 LB. 11 LB. 21 LB.	Mar 15 to Jun 1 Aug 1 to Oct 15	Lawn Areas
C Crownvetch Annual Ryegrass	45% 55%	TOTAL	4 LB. 5 LB. 9 LB.	Ryegrass Mar 1 to Oct 15 Crownvetch Nov 1 to Aug 31	E & S Control (Area not intended for mowing)
D Tall Fescue Creeping Red Fescue or Chewings Fescue	70% 30%	TOTAL	15 LB. 6 LB. 21 LB.	Mar 15 to Jun 1 Aug 1 to Oct 15	High Traffic Areas (Durable/tall grass)
E Annual Ryegrass	100%		10 LB.	Mar 15 to Oct 15 (2)	Temporary Seed (STABILIZATION)
L Hard Fescue Mixture Creeping Red Fescue	60% 40%	TOTAL	12.5 LB. 8.5 LB. 21 LB.	Mar 15 to Jun 1 Aug 1 to Oct 15	Low Traffic Areas (Short grass - shady areas)
W Tall Fescue Birdsfoot Trefoil Redtop	70% 20% 10%	TOTAL	7.5 LB 2 LB. 1 LB. 10.5 LB.	Apr 1 to Jun 15 Aug 16 to Sep 15	Embankments, Wet- land Areas or (Areas where the natural vegetation is desired)
S Tall Fescue Hard Chewings Perennial Ryegrass	50% 30% 20%	TOTAL	11 LB 6 LB 4 LB 21 LB	Mar 15 to Jun 1 Aug 1 to Oct 15	Shade Areas

Recommended Mulch, Lime and Fertilizer Rates

1. The recommended mulch application rate is 3 tons/acre.
2. The recommended fertilizer application rate is 1000 pounds/acre or 25 pounds/1000 square feet.
3. The recommended lime application rate is 3 tons ground limestone per acre or 137 pounds per 1000 square feet.

NOTES:

- (1) Seeding requirements as per PennDOT Publication No. 408, Specifications
- (2) May be planted year round, weather permitting.

SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Removal of deteriorated concrete and subsequent replacement and patching.
 - 2. Floor joint repair.
 - 3. Penetrating polymer sealers.
 - 4. Penetrating water and salt barrier.

1.3 ALLOWANCES

- A. Allowances for maintenance of cast-in-place concrete are specified in Section 012100 "Allowances."
- B. Field quality-control testing is part of testing and inspecting allowance.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of portland cement and aggregate supplied for mixing or adding to products at Project site.
- B. Product Test Reports: For each manufactured bonding agent, cementitious patching mortar joint-filler, and polymer sealer, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
- B. Store cementitious materials off the ground, under cover, and in a dry location.
- C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.7 FIELD CONDITIONS

- A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.
 - 1. Use only Class A epoxies when substrate temperatures are below or are expected to go below **40 deg F (5 deg C)** within eight hours.
 - 2. Use only Class A or B epoxies when substrate temperatures are below or are expected to go below **60 deg F (16 deg C)** within eight hours.
 - 3. Use only Class C epoxies when substrate temperatures are above and are expected to stay above **60 deg F (16 deg C)** for eight hours.
- B. Cold-Weather Requirements for Cementitious Materials: Do not apply unless concrete-surface and air temperatures are above **40 deg F (5 deg C)** and will remain so for at least 48 hours after completion of Work.
- C. Cold-Weather Requirements for Cementitious Materials: Comply with the following procedures:
 - 1. When air temperature is below **40 deg F (5 deg C)**, heat patching-material ingredients and existing concrete to produce temperatures between **40 and 90 deg F (5 and 32 deg C)**.
 - 2. When mean daily air temperature is between **25 and 40 deg F (minus 4 and plus 5 deg C)**, cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above **32 deg F (0 deg C)** within the enclosure for 48 hours after repair.
 - 3. When mean daily air temperature is below **25 deg F (minus 4 deg C)**, provide enclosure and heat to maintain temperatures above **32 deg F (0 deg C)** within the enclosure for 48 hours after repair.
- D. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of **90 deg F (32 deg C)** and above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.2 BONDING AGENTS

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ARDEX Americas.
- b. MAPEI Corporation.
- c. Sika Corporation.

- B. Epoxy Bonding Agent: ASTM C881/C881M, bonding system Type II and free of VOCs.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Dayton Superior Corporation.
- b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
- c. MAPEI Corporation.
- d. Sika Corporation.

- C. Latex Bonding Agent, Redispersible: ASTM C1059/C1059M, Type I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Dayton Superior Corporation.
- b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
- c. W. R. Meadows, Inc.

- D. Mortar Scrub Coat: Mix consisting of 1 part portland cement and 1 part fine aggregate complying with ASTM C144 except 100 percent passing a **No. 16 (1.18-mm)** sieve.

2.3 PATCHING MORTAR

- A. Patching Mortar Requirements:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.

2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.
- B. Job-Mixed Patching Mortar: 1 part portland cement and 2-1/2 parts fine aggregate complying with ASTM C144, except 100 percent passing a **No. 16 (1.18-mm)** sieve.
- C. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior Corporation.
 - b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
 - c. MAPEI Corporation.
 - d. Sika Corporation.
 - e. W. R. Meadows, Inc.
 2. Compressive Strength: Not less than **4000 psi (27.6 MPa)** at when tested according to ASTM C109/C109M.
- D. Polymer-Modified, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains a latex additive as either a dry powder or a separate liquid that is added during mixing.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas.
 - b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
 - c. Sika Corporation.
 - d. W. R. Meadows, Inc.
 2. Compressive Strength: Not less than **4000 psi (27.6 MPa)** at when tested according to ASTM C109/C109M.

2.4 JOINT FILLER

- A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.
 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. Dayton Superior Corporation.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Kaufman Products, Inc.
 - d. Sika Corporation.

2.5 MISCELLANEOUS MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.

- B. Water: Potable.

2.6 EPOXY CRACK-INJECTION MATERIALS

- A. Epoxy Crack-Injection Adhesive: ASTM C881/C881M, bonding system Type IV at structural locations and where indicated, Type I at other locations; free of VOCs.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
 - b. Kaufman Products, Inc.
 - c. Sika Corporation.
 - d. W. R. Meadows, Inc.
 2. Capping Adhesive: Product manufactured for use with crack-injection adhesive by same manufacturer.
 3. Color: Provide epoxy crack-injection adhesive and capping adhesive that blend with existing, adjacent concrete and do not stain concrete surface.

2.7 POLYMER-SEALER MATERIALS

- A. Epoxy Polymer Sealer: Low-viscosity epoxy, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 400 g/L or less.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
 - b. MAPEI Corporation.
 - c. Sika Corporation.
 2. Color: As selected by Architect from full range of industry colors.
- B. Methacrylate Polymer Sealer: Low-viscosity, high-molecular-weight methacrylate, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 400 g/L or less.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kwik Bond Polymers.
 - b. Master Builders Solutions; brand of MBCC Group.
 - c. Sika Corporation.
 2. Color: As selected by Architect from full range of industry colors.
- C. Penetrating Water and Salt Barrier:
1. Basis of design: "Saltguard VOC," PROSOCO, Inc. or equal.

2.8 MISCELLANEOUS MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.
- B. Water: Potable.

2.9 MIXES

- A. General: Mix products, in clean containers, according to manufacturer's written instructions.
 - 1. Do not add water, thinners, or additives unless recommended by manufacturer.
 - 2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
 - 3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.
- B. Concrete: Comply with Section 033000 "Cast-in-Place Concrete."
- C. Grout for Use with Preplaced Aggregate: Proportion according to ASTM C938. Add grout fluidifier to mixing water followed by portland cement, pozzolan, and fine aggregate.

PART 3 - EXECUTION

3.1 CONCRETE MAINTENANCE

- A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.
- B. Comply with manufacturers' written instructions for surface preparation and product application.

3.2 EXAMINATION

- A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.
- B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.
- C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.
- D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.3 PREPARATION

- A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.
 - 1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
 - 2. Use only proven protection methods appropriate to each area and surface being protected.
 - 3. Provide temporary barricades, barriers, and directional signage to exclude public from areas where concrete maintenance work is being performed.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.
 - 5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
 - 6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.
 - 7. Protect floors and other surfaces along haul routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
 - 9. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
 - 10. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
 - 11. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.
 - 1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- D. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.
 - 1. Verify that affected utilities have been disconnected and capped.
 - 2. Inventory and record the condition of items to be removed for reinstallation or salvage.
 - 3. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or

collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.

- E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by wire brushing until only tightly adhered light rust remains.
 - 1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.
 - 2. Remove additional concrete as necessary to provide at least **3/4-inch (19-mm)** clearance at existing and replacement bars.
 - 3. Splice replacement bars to existing bars according to **ACI 318 (ACI 318M)** by lapping, welding, or using mechanical couplings.
- F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than **3/4 inch (19 mm)** deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.
- G. Surface Preparation for Corrosion-Inhibiting Treatment: Clean concrete to remove dirt, oils, films, and other materials detrimental to treatment application.
 - 1. Use low-pressure water cleaning detergent scrubbing or sand blasting Insert requirement.
 - 2. Allow surface to dry before applying corrosion-inhibiting treatment.
- H. Surface Preparation for Overlays:
 - 1. Remove delaminated material and deteriorated concrete surface material.
 - 2. Roughen surface of concrete to produce a surface profile matching manufacturer's recommendations.
 - 3. Use scarifying or milling.
 - 4. Sweep and vacuum roughened surface to remove debris followed by low-pressure water cleaning.
- I. Acidic Surface Preparation for Sealers: Acid etch surface of concrete to produce a surface profile matching CSP 1 according to ICRI 310.2. Prepare surface for acid etching by detergent scrubbing to remove oils and films that may prevent acid penetration.
 - 1. Remove excess acid solution, reaction products, and debris by squeegeeing or vacuuming.
 - 2. Scrub surface with an alkaline detergent, rinse, and squeegee or vacuum.
 - 3. Check acidity of surface with pH test paper and continue rinsing until pH is acceptable according to sealer manufacturer's written instructions.
 - 4. When pH is acceptable according to sealer manufacturer's written instructions and surface is clean, vacuum dry.
- J. Nonacidic Surface Preparation for Sealers: Clean concrete to remove dirt, oils, films, and other materials detrimental to sealer application.
 - 1. Use low-pressure water cleaning or detergent scrubbing.

3.4 REMOVAL OF CONCRETE

- A. Do not overload structural elements with debris.

- B. Saw-cut perimeter of areas indicated for removal to a depth of at least **1/2 inch (13 mm)**. Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.
- C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
- D. Remove additional concrete if necessary to provide a depth of removal of at least **1/2 inch (13 mm)** over entire removal area.
- E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least **3/4-inch (19-mm)** clearance around bar.
- F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.
- G. Provide surfaces with a fractured profile of at least **1/8 inch (3 mm)** that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.
- H. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.5 APPLICATION OF BONDING AGENT

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars and concrete by stiff brush or hopper spray according to manufacturer's written instructions. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar or concrete.
- B. Epoxy Bonding Agent: Apply to reinforcing bars and concrete by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas. Place patching mortar or concrete while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar or concrete.
- C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar or concrete.
- D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface according to manufacturer's written instructions. Place patching mortar or concrete while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar or concrete.

3.6 INSTALLATION OF PATCHING MORTAR

- A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer.
 - 1. Provide forms where necessary to confine patch to required shape.
 - 2. Wet substrate and forms thoroughly and then remove standing water.
- B. Pretreatment: Apply specified bonding agent.

- C. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
- D. Vertical Patching: Place material in lifts of not more than **1 inch (25 mm)** or less than. Do not feather edge.
- E. Overhead Patching: Place material in lifts of not more than **1 inch (25 mm)** or less than. Do not feather edge.
- F. Consolidation: After each lift is placed, consolidate material and screed surface.
- G. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
- H. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a surface matching adjacent concrete.
- I. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.7 CONCRETE PLACEMENT

- A. Place concrete according to Section 033000 "Cast-in-Place Concrete" and as specified in this article.
- B. Standard Placement: Place concrete by form-and-pump method unless otherwise indicated.
 - 1. Use vibrators to consolidate concrete as it is placed.
 - 2. At unformed surfaces, screed concrete to produce a surface that when finished with patching mortar will match required profile and surrounding concrete.
- C. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.
- D. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.

3.8 FLOOR-JOINT REPAIR

- A. Cut out deteriorated concrete and reconstruct sides of joint with patching mortar as indicated on Drawings. Install joint filler in nonmoving floor joints where indicated and as specified in this article.
- B. Depth: Install joint filler to a depth of at least **1 inch (25 mm)**. Use fine silica sand no more than **1/4 inch (6 mm)** deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.
- C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

3.9 EPOXY CRACK INJECTION

- A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.
- B. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond.
- C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.
- D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least **1/4 inch (6 mm)** thick by **1 inch (25 mm)** wider than crack.
- E. Inject cracks wider than **0.003 inch (0.075 mm)** to a depth of **8 inches (200 mm)**.
- F. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.
- G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.10 APPLICATION OF POLYMER SEALER

- A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.
- B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Packaged, Cementitious Patching Mortar: randomly selected sets of samples for each type of mortar required, tested according to ASTM C928/C928M.
 - 2. Job-Mixed Patching Mortar: randomly selected sets of samples for each type of mortar required, tested for compressive strength according to ASTM C109/C109M.
 - 3. Concrete: As specified in Section 033000 "Cast-in-Place Concrete."
- C. Product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 030130

SECTION 031000
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formwork for cast-in-place concrete.
2. Shoring, bracing, and anchorage.
3. Architectural form liners.
4. Form accessories.
5. Form stripping.

B. Related Requirements:

1. Section 032000 - Concrete Reinforcing: Reinforcing steel and required supports for cast-in-place concrete.
2. Section 033000 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frame, slabs-on-grade, and other concrete components associated with building.

1.2 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

B. American Forest & Paper Association:

1. AF&PA - National Design Specification (NDS) for Wood Construction.

C. American Society of Mechanical Engineers:

1. ASME A17.1 - Safety Code for Elevators and Escalators.

D. APA - The Engineered Wood Association:

1. APA/EWA PS 1 - Voluntary Product Standard - Structural Plywood.

E. ASTM International:

1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
3. ASTM E96M - Standard Test Methods for Water Vapor Transmission of Materials.

F. West Coast Lumber Inspection Bureau:

1. WCLIB - Standard No. 17 Grading Rules for West Coast Lumber.

1.3 COORDINATION

- A. Section 013000 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on void form materials and installation requirements.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statement:
 1. Submit qualifications for licensed professional.

1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 347 & 301.
- B. For wood products furnished for Work of this Section, comply with AF&PA.
- C. Perform Work according to Borough standards.
- D. Maintain a copy of each standard affecting Work of this Section on Site.

1.6 QUALIFICATIONS

- A. Licensed Professional: experienced in design of specified Work and licensed in State of PA.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept void forms on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design, engineer, and construct formwork, shoring, and bracing according to ACI 347 to conform to design and applicable Borough code requirements to achieve concrete shape, line, and dimension as indicated on Drawings.
- B. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, desiccant or water method.

2.2 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.
- B. Plywood Forms:
 - 1. Application: Exposed finish concrete.
 - 2. Description:
 - a. Comply with APA/EWA PS 1.
 - b. Label each panel with grade trademark of APA/EWA.
 - 3. Plywood for Surfaces to Receive Membrane Waterproofing:
 - a. Minimum Thickness: 5/8 inch.
 - b. Grade: APA/EWA "B-B Plyform Structural I Exterior."
 - 4. Plywood with "Smooth Finish" Indicated on Drawings:
 - a. Minimum Thickness: 3/4 inch.
 - b. Grade: APA/EWA "HD Overlay Plyform Structural I Exterior."

2.3 PREFABRICATED FORMS

- A. Furnish materials according to Borough standards.
- B. Preformed Steel Forms:
 - 1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - 2. Minimum Thickness: 20 gage.
- C. FRP Forms: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- D. Pan:
 - 1. Material: Steel or Glass fiber.
 - 2. Configuration: Size and profile as required.
- E. Tubular Column:
 - 1. Description: Round
 - 2. Surface Treatment: Release agent, non-reusable.
- F. Void Forms:
 - 1. Moisture-resistant treated paper faces; biodegradable.
 - 2. Structurally sufficient to support weight of wet concrete mix until initial set.
 - 3. Thickness: 2 inches.
- G. Steel Forms:
 - 1. Description: Sheet steel, suitably reinforced.
- H. Form Liners: Smooth, durable, grainless, and non-staining hardboard unless otherwise indicated on Drawings.
- I. Framing, Studding, and Bracing: Stud or No. 3 structural light-framing grade.

2.4 ARCHITECTURAL FORM LINERS

- A. Furnish materials according to Borough standards.

2.5 FORMWORK ACCESSORIES

- A. Form Ties:
 - 1. Type: Removable.

B. Spreaders:

1. Description: Standard, non-corrosive metal-form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face.

C. Form Release Agent:

1. Description: Colorless mineral oil that will not stain concrete or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

D. Vapor Retarder:

1. Description: Polyethylene sheet.
2. Thickness: 8 mils.

E. Bituminous Joint Filler: Comply with ASTM D1751.

F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

G. Waterstop:

1. Material: Rubber.
2. Tensile Strength: Minimum 1,750 psi.
3. Working Temperature Range: Minus 50 to plus 175 degrees F.
4. Corner Sections: Preformed.

2.6 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify lines, levels, and centers before proceeding with formwork.
- C. Verify that dimensions agree with Shop Drawings.
- D. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

2.7 INSTALLATION

- A. Earth Forms: Not permitted.
- B. Formwork:
 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.

2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
4. Positioning:
 - a. Carefully verify horizontal and vertical positions of forms.
 - b. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.
6. Erect formwork, shoring, and bracing to achieve design requirements according to ACI 301.
7. Stripping:
 - a. Arrange and assemble formwork to permit dismantling and stripping.
 - b. Do not damage concrete during stripping.
 - c. Permit removal of remaining principal shores.
8. Obtain approval of Architect/Engineer before framing openings in structural members not indicated on Drawings.
9. Install void forms according to manufacturer instructions.
10. Do not patch formwork.
11. Leave forms in place for minimum number of days according to ACI 347.

C. Form Removal:

1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, and removal has been approved by Architect/Engineer.
2. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
3. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
4. Discard damaged forms.
5. Form Release Agent:
 - a. Apply according to manufacturer instructions.
 - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
 - c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
 - d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
6. Form Cleaning:
 - a. Clean forms as erection proceeds to remove foreign matter within forms.
 - b. Clean formed cavities of debris prior to placing concrete.
 - c. Flush with water or use compressed air to remove remaining foreign matter.

- d. Ensure that water and debris drain to exterior through cleanout ports.
- e. Cold Weather:
 - 1) During cold weather, remove ice and snow from within forms.
 - 2) Do not use de-icing salts.
 - 3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.

7. Reuse and Coating of Forms:

- a. Thoroughly clean forms and reapply form coating before each reuse.
- b. For exposed Work, do not reuse forms with damaged faces or edges.
- c. Apply form coating to forms according to manufacturer instructions.
- d. Do not coat forms for concrete indicated to receive "scored finish."
- e. Apply form coatings before placing reinforcing steel.

D. Forms for Smooth Finish Concrete:

- 1. Use steel, plywood, or lined-board forms.
- 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
- 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
- 4. Use full-sized sheets of form liners and plywood wherever possible.
- 5. Tape joints to prevent protrusions in concrete.
- 6. Apply forming and strip wood forms in a manner to protect corners and edges.
- 7. Level and continue horizontal joints.
- 8. Keep wood forms wet until stripped.

E. Forms for Surfaces to Receive Membrane Waterproofing:

- 1. Use plywood or steel forms.
- 2. After erection of forms, tape form joints to prevent protrusions in concrete.

F. Framing, Studding, and Bracing:

- 1. Maximum Spacing of Studs:
 - a. Boards: Maximum 16 inches o.c.
 - b. Plywood: 12 inches o.c.
- 2. Size framing, bracing, centering, and supporting members for sufficient strength to maintain shape and position under imposed loads from construction operations.
- 3. Construct beam soffits of material minimum 2 inches thick.
- 4. Distribute bracing loads over base area on which bracing is erected.
- 5. When placed on ground, protect against undermining, settlement, and accidental impact.

G. Form Anchors and Hangers:

1. Do not use anchors and hangers leaving exposed metal at concrete surface.
2. Symmetrically arrange hangers supporting forms from structural-steel members to minimize twisting or rotation of member.
3. Penetration of structural-steel members is not permitted.

H. Inserts, Embedded Parts, and Openings:

1. Install formed openings for items to be embedded in or passing through concrete Work.
2. Locate and set in place items required to be cast directly into concrete.
3. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.
4. Joints:
 - a. Install waterstops continuous without displacing reinforcement.
5. Openings:
 - a. Provide temporary ports or openings in formwork as required to facilitate cleaning and inspection.
 - b. Locate openings at bottom of forms to allow flushing water to drain.
6. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.

I. Form Ties:

1. Provide sufficient strength and quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.

J. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

K. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Appearance:
 - a. Show no overlapping of construction joints.
 - b. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true, and sharp.

L. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.

M. Openings for Items Passing through Concrete:

1. Frame openings in concrete where indicated on Drawings.
2. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
3. Coordinate Work to avoid cutting and patching of concrete after placement.
4. Perform cutting and repairing of concrete required as result of failure to provide required openings.

N. Screeds:

1. Set screeds and establish levels for tops of and finish on concrete slabs.
2. Slope slabs to drain where required or as indicated on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms; remove freestanding water.

O. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
2. Staking through membrane is not permitted.

P. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed.
3. Remove chips, sawdust, and other debris.
4. Thoroughly blow out forms with compressed air just before concrete is placed.

2.8 TOLERANCES

- A. Construct formwork to maintain tolerances according to ACI 301.
- B. Camber:
1. According to ACI 301.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

- a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 1. Do not cut or puncture vapor retarder.
 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Install welded-wire reinforcement in longest practicable lengths.
 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

- a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 1. Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete standards, materials, mixture design, placement procedures, treatments and finishes for the following:
 - a. Concrete Footings.
 - b. Slabs-on-grade.
 - c. Curbs.
 - d. Driveway Aprons.
 - e. Sidewalks and Ramps.
 - f. Curb Ramps.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for forming.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

- A. Cementitious Materials:** Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm):** The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures:
6. Vapor retarders.
7. Curing and weatherproofing materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Maximum w/cm.

4. Slump limit.
5. Air content.
6. Nominal maximum aggregate size.
7. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
2. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional detailing fabrication, assembly and support of formwork.
 - a. Shoring and Reshoring: Indicated proposed schedule and sequence of stripping formwork, shoring removal and installing and removing reshoring.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Qualification Data: For installer, manufacturer and testing agency.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Vapor retarders.
5. For materials and form-release agents.
6. Waterstops.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures:

E. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

1.5 QUALITY ASSURANCE

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Installer Qualifications: A qualified installer who employs on Project personnel qualified to perform work.
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 2. Comply with ACI 305R when pouring concrete during hot weather.
 - 3. Comply with ACI 306.1 when pouring concrete during cold weather.
 - 4. Acquire cement and aggregate from one source for Work.
 - 5. Maintain 1 copy of each standard affecting Work of this Section on Site.
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.
- B. Comply with PennDOT Publication 408 Specifications, to supersede any opposing specifications.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type I or Type II, gray.
 - 2. Fly Ash: ASTM C618, Class C or F.
 - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C33/C33M coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
- C. Air-Entraining Admixture: ASTM C260/C260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum. VAPOR RETARDERS

- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing, waterproofing, or coal tar finish.
- G. Sheet Vapor Retarder, Class A: ASTM E1745, Class A not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- H. Sheet Vapor Barrier, Class A: ASTM E1745, Class A not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
- C. Curing Paper: 8-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- D. Water: Potable or complying with ASTM C1602/C1602M.
- E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
 - 1. Basis of design: "SingleStep Cure-and-Seal," PROSOCO, Inc. or equal.

2.5 RELATED MATERIALS

2.6 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete and concrete with a w/cm below 0.50.

2.7 CONCRETE MIXTURES

A. Footings: Normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch.
3. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

B. Interior slabs-on-grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
5. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

C. Exterior slabs-on-grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
6. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

D. Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 2. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.9 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Profile: Flat, dumbbell with center bulb.
 - 2. Dimensions: length as indicated by 3/8 inch thick; nontapered.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types II, non-load bearing, IV, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Do not chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 36 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Construction Manager.

3.3 SHORES AND RESHORES

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

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.5 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.6 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- E. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.8 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish:
1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 3. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish:
1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.

5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 7. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and also no more than 1/16 inch in 2 feet.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 3000 psi at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
 2. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE PROTECTING AND CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Curing Formed Surfaces: Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

3.11 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Apply per manufacturer's instructions for New and Existing concrete accordingly.
 - 3. Apply two coats.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect or Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch-wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.

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

3.14 TOLERANCES

- A. Conform to ACI 117.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.

- 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Verification of use of required design mixture.
2. Concrete placement, including conveying and depositing.
3. Curing procedures and maintenance of curing temperature.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

9. Additional Tests:

- a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.

END OF SECTION 033000

SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Self-leveling, gypsum cement underlayment for application below interior floor coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Gypsum cement underlayment.
 - 2. Primer.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Data: For each type of product

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
 - 1. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

PART 2 - PRODUCTS

2.1 GYPSUM CEMENT UNDERLAYMENTS

- A. Gypsum Cement Underlayment: Self-leveling, gypsum cement product that can be applied in minimum uniform thickness of 1/8 inch (3 mm) to match adjacent floor elevations.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Novoplan 2 Plus or a comparable product by one of the following:
 - a. Maxxon Corporation.
 - b. USG Corporation.
2. Cement Binder: Gypsum or blended gypsum cement as defined by ASTM C219.
3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C472.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- D. Primer: Provide MAPEI Corporation; Primer-T or product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare and clean substrate according to manufacturer's written instructions.
 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Mix and install underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
 2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Install underlayment to produce uniform, level surface.
1. Install a final layer without aggregate to product surface.
 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035413

SECTION 040110 - MASONRY CLEANING

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 cleaning the following:

- 1. Unit masonry surfaces.
- 2. Stone surfaces.

1.3 DEFINITIONS

- A. Very Low-Pressure Spray: Under 100 psi (690 kPa).
- B. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
- C. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
 - a. Verify masonry-cleaning equipment and facilities needed to make progress and avoid delays.
 - b. Materials, material application, and sequencing.
 - c. Cleaning program.

1.5 SEQUENCING AND SCHEDULING

- A. Work Sequence: Perform masonry-cleaning work in the following sequence:
 - 1. Remove plant growth.
 - 2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
 - 3. Remove paint.
 - 4. Clean masonry surfaces.

5. Where water repellents are to be used on or near masonry, delay application of these chemicals until after cleaning.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include material descriptions and application instructions.
 2. Include test data substantiating that products comply with requirements.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For paint-remover manufacturer and chemical-cleaner manufacturer.
- B. Preconstruction Test Reports: For cleaning materials and methods.
- C. Cleaning program.

1.8 QUALITY ASSURANCE

- A. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.
- B. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.
- C. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.
 1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness for this Project.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to remain so for at least seven days after completion of cleaning.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

- A. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation, for removing paint from masonry; containing no methanol or methylene chloride.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American Building Restoration Products, Inc.
 - b. Cathedral Stone Products, Inc.
 - c. Dumond Chemicals, Inc.
 - d. EaCo Chem, Inc.

2.2 CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).
- C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.
- D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.
- E. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American Building Restoration Products, Inc.
 - b. Cathedral Stone Products, Inc.
 - c. Hydroclean; Hydrochemical Techniques, Inc.
 - d. Prosoco, Inc.
- F. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American Building Restoration Products, Inc.
 - b. Cathedral Stone Products, Inc.
 - c. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
 - d. Prosoco, Inc.

2.3 ACCESSORY MATERIALS

- A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Building Restoration Products, Inc.
 - b. Price Research, Ltd. dba Charles Paint Research.
 - c. Prosoco, Inc.

2.4 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
 - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
 - 3. Neutralize alkaline and acid wastes before disposal.
 - 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.

- B. Proceed with cleaning in an orderly manner. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use only those cleaning methods indicated for each masonry material and location.
 - 1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
 - 2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
 - a. Equip units with pressure gages.
 - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
 - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
 - d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.
- F. Water Application Methods:
 - 1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
 - 2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
 - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
- I. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.3 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.
 - 1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
 - 2. Remove paint and calking with alkaline paint remover.
 - a. Comply with requirements in "Paint Removal" Article.
 - b. Repeat application up to two times if needed.
 - 3. Remove asphalt and tar with solvent-type paste paint remover.
 - a. Comply with requirements in "Paint Removal" Article.
 - b. Apply paint remover only to asphalt and tar by brush without prewetting.
 - c. Allow paint remover to remain on surface for 10 to 30 minutes.
 - d. Repeat application if needed.

3.4 PAINT REMOVAL

- A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- B. Paint Removal with Alkaline Paste Paint Remover:
 - 1. Remove loose and peeling paint using low or medium-pressure water spray (using low spray first to test efficacy), scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply paint remover to dry, painted surface with brushes.
 - 3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
 - 4. Rinse with water applied by low-pressure spray to remove chemicals and paint residue.
 - 5. Repeat process if necessary to remove all paint.
 - 6. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
 - 7. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
- C. Paint Removal with Solvent-Type Paste Paint Remover:
 - 1. Remove loose and peeling paint using low or medium-pressure water spray (using low spray first to test efficacy), scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.

2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with water applied by low-pressure spray to remove chemicals and paint residue.

3.5 CLEANING MASONRY

A. Detergent Cleaning:

1. Wet surface with water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with water applied by low-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

C. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with water applied by low-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.

5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.6 FINAL CLEANING

- A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

END OF SECTION 040110

SECTION 040120.63 - BRICK MASONRY REPAIR

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. Repairing brick masonry.
 - 2. Removing abandoned anchors.
- B. Related Requirements:
 - 1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.

1.3 ALLOWANCES

- A. Allowances for brick masonry repair are specified in Section 012100 "Allowances."
- B. Abandoned anchor removal is part of brick masonry repair allowance.
- C. Brick removal and replacement is part of brick masonry repair allowance.
- D. Patching brick masonry is part of brick masonry repair allowance.

1.4 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
- B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.
- C. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of bricks to freezing and thawing.

1.5 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 recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Samples for Initial Selection: For the following:

1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches (150 mm) long by 1/4 inch (6 mm) wide, set in aluminum or plastic channels.
 - a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
 - b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.
2. Sand Types Used for Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars.
3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.
4. Include similar Samples of accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For brick masonry contractor identifying experience in repair and patching work.
- B. Quality-control program.

1.7 QUALITY ASSURANCE

- A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.
 1. Field Supervision: Brick masonry repair specialist firm shall maintain experienced full-time supervisors on Project site during times that brick masonry repair work is in progress.
- B. Mockups: Prepare mockups of brick masonry repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.
 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver bricks to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.
- B. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- E. Store sand where grading and other required characteristics can be maintained and contamination avoided.
- F. Handle bricks to prevent overstressing, chipping, defacement, and other damage.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Temperature Limits: Repair brick masonry only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.
- C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:
 - 1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
 - 2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after repair.
- D. Hot-Weather Requirements: Protect masonry repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.
- E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Source Limitations: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

- A. Face Brick: As required to complete brick masonry repair work.
 - 1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork and with physical properties
- B. Building Brick: ASTM C62, of same vertical dimension as face brick, for masonry work concealed from view.
 - 1. Grade SW where in contact with earth.
 - 2. Grade SW or MW for concealed backup.

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.
 - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Mortar Sand: ASTM C144.
 - 1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
 - 2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
- D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.
- E. Water: Potable.

2.4 MANUFACTURED REPAIR MATERIALS

- A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Cathedral Stone Products, Inc.
 - b. Conproco Corporation.
 - c. Edison Coatings, Inc.
2. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than bricks being repaired, and develops high bond strength to all types of masonry.
3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
4. Formulate patching compound in colors and textures to match each brick being patched. Provide sufficient number of colors to enable matching of the color, texture, and variation of each unit.

2.5 ACCESSORY MATERIALS

- A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.
- B. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.
- C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating Insert requirement.
 1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning" surface preparation according to manufacturer's literature or certified statement.
 2. VOC Limit: Use coating with a VOC content of 400 g/L (3.3 lb/gal.) or less.
- D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
 1. Previous effectiveness in performing the work involved.
 2. Minimal possibility of damaging exposed surfaces.
 3. Consistency of each application.
 4. Uniformity of the resulting overall appearance.
 5. Do not use products or tools that could leave residue on surfaces.

2.6 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
 1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black

which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

- C. Do not use admixtures in mortar unless otherwise indicated.
- D. Mixes: Mix mortar materials in the following proportions:
 - 1. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime or mortar cement.
 - 2. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Prevent mortar from staining face of surrounding masonry and other surfaces.
 - 1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
 - 2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
 - 3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.
- B. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repair. Reinstall when repairs are complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

- A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.

3.3 ABANDONED ANCHOR REMOVAL

- A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.
 - 1. Remove items carefully to avoid spalling or cracking masonry.
 - 2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:
 - a. Cut or grind off item approximately 3/4 inch (20 mm) beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
 - b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.
 - 3. Patch hole where each item was removed unless directed to remove and replace bricks.

3.4 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
 - 1. When removing single bricks, remove material from center of brick and work toward outside edges.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.
- D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Remove in an undamaged condition as many whole bricks as possible.
 - 1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
 - 2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
 - 3. Store brick for reuse. Store off ground, on skids, and protected from weather.
 - 4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.
- F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.
- G. Replace removed damaged brick with other removed brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.
- H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
 - 1. Maintain joint width for replacement units to match existing joints.
 - 2. Use setting buttons or shims to set units accurately spaced with uniform joints.
- I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.) Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
 - 1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
 - 2. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
- J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.5 PAINTING STEEL UNCOVERED DURING THE WORK

- A. Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:
 1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning", as applicable to comply with paint manufacturer's recommended preparation.
 2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).
- B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch (1.6 mm), notify Architect before proceeding.

3.6 BRICK MASONRY PATCHING

- A. Patch the following bricks unless another type of repair or replacement is indicated:
 1. Bricks and brick areas indicated to be patched.
 2. Bricks with holes larger than 1/2 inch diameter
 3. Bricks with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch (19 mm) in least dimension.
 4. Bricks with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch (19 mm) in least dimension and more than 1/4 inch (6 mm) deep.
- B. Patching Bricks:
 1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than recommended in writing by patching compound manufacturer.
 2. Rinse surface to be patched and leave damp, but without standing water.
 3. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
 4. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
 5. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
 6. Keep each layer damp for 72 hours or until patching compound has set.
 7. Remove and replace patches with hairline cracks or that show separation from brick at edges, and those that do not match adjoining brick in color or texture.

3.7 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
 - 1. Do not use metal scrapers or brushes.
 - 2. Do not use acidic or alkaline cleaners.
- B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Remove masking materials, leaving no residues that could trap dirt.

3.8 FIELD QUALITY CONTROL

- A. Project Representatives: Architect and/or Construction Manager will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

3.9 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.
- B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 040120.63

SECTION 040120.64 - BRICK MASONRY REPOINTING

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. Repointing joints with mortar.
 - 2. Repointing joints with sealant.
- B. Related Requirements:
 - 1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
 - 2. Section 040120.63 "Brick Masonry Repair" for information on repairing masonry in preparation for repointing.
 - 3. Section 071900 "Water Repellants" for information on surface preparation for water repellent application.
 - 4. Section 079200 "Joint Sealants" for sealants to be used in brick masonry assemblies.

1.3 ALLOWANCES

- A. Allowances for repointing brick masonry are specified in Section 012100 "Allowances."
- B. Repointing brick masonry is part of masonry repointing allowance.

1.4 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."
 - 1. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.5 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.6 SEQUENCING AND SCHEDULING

- A. Order sand and gray portland cement for pointing mortar immediately after approval of mockups. Take delivery of and store at Project site enough quantity to complete Project.
- B. Work Sequence: Perform brick masonry repointing work in the following sequence, which includes work specified in this and other Sections:
 - 1. Remove plant growth.
 - 2. Inspect masonry for open mortar joints and permanently or temporarily point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
 - 3. Remove paint.
 - 4. Clean masonry.
 - 5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
 - 6. Repair masonry, including replacing existing masonry with new masonry materials.
 - 7. Rake out mortar from joints to be repointed.
 - 8. Point mortar and sealant joints.
 - 9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
 - 10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.
- C. If scaffolding is required, as scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in bricks according to Section 040120.63 "Brick Masonry Repair." Patch holes in mortar joints according to "Repointing" Article.

1.7 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 recommendations for product application and use.
 - 3. Include test data substantiating that products comply with requirements.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and locations of repointing work on the structure.
 - 2. Show provisions for expansion joints or other sealant joints.
 - 3. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.
- C. Samples for Initial Selection: For the following:
 - 1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches (150 mm) long by 1/4 inch (6 mm) wide, set in aluminum or plastic channels.
 - a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
 - b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.

2. Sand Type Used for Pointing Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars.
3. Sealant materials.
4. Include similar Samples of accessories involving color selection.

1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For brick masonry repointing specialist.

1.9 QUALITY ASSURANCE

- A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.
 1. Field Supervision: Brick masonry repointing specialist firms shall maintain experienced full-time supervisors on Project site during times that brick masonry repointing work is in progress.
- B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.
- C. Mockups: Prepare mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.
 1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide for each type of repointing required, and repoint one of the areas.
 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. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- D. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.11 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repointing work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Temperature Limits: Repoint mortar joints only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.
- C. Cold-Weather Requirements: Comply with the following procedures for mortar-joint pointing unless otherwise indicated:
 - 1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
 - 2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after pointing.
- D. Hot-Weather Requirements: Protect mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Source Limitations: Obtain each type of material for repointing brick masonry (cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.
 - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Mortar Sand: ASTM C144.
 - 1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
 - 2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

- D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.
- E. Water: Potable.

2.3 ACCESSORY MATERIALS

A. Sealant Materials:

- 1. Sealant manufacturer's standard elastomeric sealant(s) of base polymer and characteristics indicated below and according to applicable requirements in Section 079200 "Joint Sealants."
 - a. Type: Per Sealant Schedule in Section 079200 "Joint Sealants"
- 2. Colors: Provide colors of exposed sealants to match colors of mortar adjoining installed sealant unless otherwise indicated.
- 3. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing the No. 100 sieve.

B. Joint-Sealant Backing:

- 1. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- 2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended in writing by sealant manufacturer for preventing sealant from adhering to rigid, inflexible, joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

C. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

- 1. Previous effectiveness in performing the work involved.
- 2. Minimal possibility of damaging exposed surfaces.
- 3. Consistency of each application.
- 4. Uniformity of the resulting overall appearance.
- 5. Do not use products or tools that could leave residue on surfaces.

2.4 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

- 1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this

dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

- B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
 - 1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.
- C. Do not use admixtures in mortar unless otherwise indicated.
- D. Mixes: Mix mortar materials in the following proportions:
 - 1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand. Add mortar pigments to produce mortar colors required but do not add pigment exceeding 10% by weight of the cementitious or binder materials.

PART 3 - EXECUTION

3.1 REPOINTING SPECIALIST

- A. Brick Masonry Repointing Specialist Firms: Subject to compliance with requirements, have masonry repointing performed by firms and experienced personnel complying with requirements identified under Quality Assurance Article 1.9:

3.2 PROTECTION

- A. Prevent mortar from staining face of surrounding masonry and other surfaces.
 - 1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
 - 2. Keep wall area wet below pointing work to discourage mortar from adhering.
 - 3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.
- B. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repointing. Reinstall when repointing is complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.3 MASONRY REPOINTING, GENERAL

- A. Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.
- B. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
 2. Joints indicated as sealant-filled joints.
 3. Joints at locations of the following defects:
 - a. Holes and missing mortar.
 - b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
 - c. Cracks 1/8 inch (3 mm) or more in width and of any depth.
 - d. Hollow-sounding joints when tapped by metal object.
 - e. Eroded surfaces 1/4 inch (6 mm) or more deep.
 - f. Deterioration to point that mortar can be easily removed by hand, without tools.
 - g. Joints filled with substances other than mortar.
- C. Do not rake out and repoint joints where not required.
- D. Rake out joints as follows, according to procedures demonstrated in approved mockup:
1. Remove mortar from joints to depth of 2 times joint width and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.
 2. Remove mortar from brick and other masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
 3. Do not spall edges of brick or other masonry units or widen joints. Replace or patch damaged brick or other masonry units as directed by Architect.
- E. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- F. Pointing with Mortar:
1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
 2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
 3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
 4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
 5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
 6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.
- G. Pointing with Sealant: Comply with Section 079200 "Joint Sealants." and as follows:

1. After raking out, keep joints dry and free of mortar and debris.
 2. Clean and prepare joint surfaces. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
 3. Fill sealant joints with specified joint sealant.
 - a. Install cylindrical sealant backing beneath the sealant. Where space is insufficient for cylindrical sealant backing, install bond-breaker tape.
 - b. Install sealant using only proven installation techniques that ensure that sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
 - c. Install sealant as recommended in writing by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:
 - 1) Fill joints to a depth equal to joint width, but not more than 1/2 inch (13 mm) deep or less than 1/4 inch (6 mm) deep.
 - d. Tool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant from surfaces adjacent to joint.
 - e. Sanded Joints: Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Lightly retool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.
 - f. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.
- H. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
1. Do not use metal scrapers or brushes.
 2. Do not use acidic or alkaline cleaners.
- B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Remove masking materials, leaving no residues that could trap dirt.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.
- B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.
- C. Notify Owner's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Owner's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

END OF SECTION 040120.64

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Lintels.
3. Brick.
4. Mortar and grout materials.
5. Reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Accessories.
9. Mortar and grout mixes.
10. Bituminous dampproofing.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.

C. Related Requirements:

1. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.
2. Section 072100 "Thermal Insulation" for cavity wall insulation.
3. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

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 the following:
1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
 2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R.
 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:**

1. Clay face brick, in the form of straps of five or more bricks.
2. Colored mortar.

D. Samples for Verification: For each type and color of the following:

1. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.4 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type of the following:

1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
2. Integral water repellent used in clay masonry.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

1.5 MOCKUPS

A. Sample Panel Mockups: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 24 inches long by 32 inches high.
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Clean exposed faces of panels with masonry cleaner indicated.
5. Protect approved sample panels from the elements with weather-resistant membrane.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.
7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches (610 mm) down both sides of walls, and hold cover securely in place.
 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (610 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with ACI 216.1.

2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C90, normal weight.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).
 - 2. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.
 - 3. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
- C. Concrete Building Brick: ASTM C55, normal weight.

2.4 LINTELS

- A. Solid Concrete Masonry Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated.
- B. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 032000 "Concrete Reinforcing," and with reinforcing bars indicated.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
- B. Clay Face Brick: Facing brick complying with ASTM C216 or hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area), Grade SW, Type FBX or Type HBX.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by but not limited to the following:
 - a. Watsontown Brick.
 - b. Boral Bricks, Inc; Boral Limited.
 - c. Glen-Gery Corporation.

2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M.
 3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
 4. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 ft. (3 m).
 5. Size (Actual Dimensions): Match existing adjacent dimensions.
 6. Application: Use where brick is exposed unless otherwise indicated.
 7. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.
 8. Color and Texture: As selected by Architect.
- C. Building (Common) Brick: ASTM C62, Grade SW.
1. Application: Use where brick is indicated for concealed locations. Face brick complying with requirements for grade, compressive strength, and size indicated for building brick may be substituted for building brick.
- D. Hollow Brick: ASTM C652, Grade SW, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area), Type HBX.
1. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
 2. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 ft. (3 m).
 3. Size (Actual Dimensions): Match existing dimensions.
 4. Application: Use where brick is exposed unless otherwise indicated.
 5. Where shown to "match existing," provide hollow brick matching color range, texture, and size of existing adjacent brickwork.
 6. Color and Texture: As selected by Architect.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.
- E. Mortar Cement: ASTM C1329/C1329M.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

- G. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 2. Pigments do not exceed 10 percent of portland cement by weight.
 - 3. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.
- H. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime masonry cement or mortar cement, sand, mortar pigments, and admixtures and complying with ASTM C1714/C1714M.
- I. Aggregate for Mortar: ASTM C144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch (6.4 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- J. Aggregate for Grout: ASTM C404.
- K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- L. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
 - 1. Interior Walls: Mill-galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (406 mm) o.c.
 - 7. Provide in lengths of not less than 10 ft. (3 m), with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

- E. Masonry-Joint Reinforcement for Multiwythe Masonry:
1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches (102 mm) wide, plus one side rod at each wythe of masonry 4 inches (102 mm) wide or less.
 2. Tab type, either ladder or truss design, with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe, but with at least 5/8-inch (16-mm) cover on outside face.
 3. 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 (1.6 mm) and maximum vertical adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) 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. Mill-Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A641/A641M, Class 1 coating.
 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
 3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.
 4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (51 mm) long for masonry constructed from solid units.
 2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
 3. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls unless otherwise indicated.
- D. 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- (6.4-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

- E. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (10-mm-) diameter metal rod 6 inches (152 mm) 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.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.4 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.
 - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.
- G. Adjustable Masonry-Veneer Anchors:
 - 1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf (445 N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.6 mm).
 - 2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0785-inch- (1.99-mm-) thick steel sheet, galvanized after fabrication.
 - 3. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
 - 4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
 - 5. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie and washer at face of insulation.
 - 6. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie.
 - 7. Masonry-Veneer Anchors; Slotted Plate: Sheet metal anchor section, with screw holes at top and bottom; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.
 - 8. Masonry-Veneer Anchors; Slotted Plate with Prongs: Sheet metal anchor section, with screw holes at top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.
 - 9. Masonry-Veneer Anchors; Single-Barrel Screw: Self-drilling, single-barrel screw designed to receive wire tie. Screw has a smooth barrel the same thickness as insulation.
 - 10. Masonry-Veneer Anchors; Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling, single-barrel screw with wingnut head designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation.

2.9 EMBEDDED FLASHING

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2438 mm) long minimum, but not exceeding 12 ft. (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with sawtooth ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate through-wall flashing with sealant stop where indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6.4 mm) to form a stop for retaining sealant backer rod.
6. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
7. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6.4 mm) to form a stop for retaining sealant backer rod.
8. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
9. Solder metal items at corners.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2-mil (0.05-mm) of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric, to produce an overall thickness of 40-mil (1.0-mm).
2. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil (0.05 mm) of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric with a permanent, clear adhesive, to produce an overall thickness of 10 mil (0.25 mm).
 - a. Applications: Use 10-mil- (0.25-mm-) thick flashing at windows, doors, and small wall penetrations; not at base of walls. Use 40-mil- (1.0-mm-) thick flashing at base of walls.
3. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 40 mil (1.0 mm).
 - a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymers alloy.
 - a. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 25 mil (0.64 mm) thick, with a 15-mil- (0.38-mm-) thick coating of adhesive.
 - 1) Color: As selected by Architect.
 - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Drainage Plane Flashing: Fabricate from stainless steel and drainage membrane to shapes indicated, including weep tabs, termination bar, and drip edge. Provide flashing materials as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.
 2. Fabricate continuous flashings in sections 60 inches (1524 mm) long, minimum.
 3. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
1. Solder for Stainless Steel: ASTM B32, Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
- E. 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.
- F. Termination Bars for Flexible Flashing: Aluminum or Stainless steel bars 1/8 inch by 1 inch (3.2 mm by 25 mm).
- G. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm) or Aluminum sheet 0.064 inch by 1-1/2 inches (1.63 mm by 38 mm) with a 3/8-inch (10-mm) flange at top.

2.10 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vents: Use one of 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 (3.2 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
 2. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Mortar Deflector: Strips, full depth of cavity and 10 inches (254 mm) high, with dovetail-shaped notches that prevent clogging with mortar droppings.
 2. Provide product with insect-resistant fabric facing.

- F. Proprietary Acidic Masonry 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.

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 masonry cement or mortar cement 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 C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type N.
 - 3. For mortar parge coats, use Type S.
 - 4. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 5. For interior nonload-bearing partitions, Type O may be used instead of 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 do not exceed 10 percent of portland cement by weight.
 - 2. Pigments do not exceed 5 percent of masonry cement or 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 C476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured in accordance with ASTM C143/C143M.

- G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

2.12 COLD-APPLIED, EMULSIFIED-ASPHAL DAMPPROOFING

- A. Trowel Coats: ASTM D1227, Type II, Class 1.
- B. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.
- C. Brush and Spray Coats: ASTM D1227, Type III, Class 1.
- D. Auxiliary Materials:
 - 1. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
 - 2. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
 - 3. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6.4 mm).
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) 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 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) 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 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) 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 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
- 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.6 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

- 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm), with a maximum thickness limited to 1/2 inch (13 mm).
- 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3.2 mm).
- 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6.4 mm).
- 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3.2 mm).
- 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.6 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (102 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches (610 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1219 mm) o.c. unless otherwise indicated.
 - 2. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay 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.

5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- 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. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
 4. Rake out mortar joints for pointing with sealant.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together using one of the following methods:
 1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. (0.25 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (914 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
 2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.
- B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
 1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are indicated at juncture, bond walls together as follows:
 1. Provide individual metal ties not more than 16 inches (406 mm) o.c.

3.7 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. (0.25 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (914 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
 - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.
 2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.
 - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.
 3. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. 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.
- D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.
- E. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (305 mm) 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 indicated.
1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.8 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (152 mm).
1. Space reinforcement not more than 16 inches (406 mm) o.c.

2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 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 1/2 inch (13 mm) 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 (610 mm) o.c. vertically and 36 inches (914 mm) o.c. horizontally.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
- C. Form expansion joints in brick as follows:
1. Build in compressible joint fillers where indicated.
 2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.11 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete masonry or offset angle support lintels where indicated and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

3.12 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.
- 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 (203 mm), and 1-1/2 inches (38 mm) into the inner wythe.
 - 3. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (203 mm); with upper edge tucked under water-resistive barrier, lapping at least 4 inches (102 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.
 - 4. At lintels and shelf angles, extend flashing 6 inches (152 mm) minimum at each end. At heads and sills, extend flashing 6 inches (152 mm) minimum and turn ends up not less than 2 inches (51 mm) to form end dams.
 - 5. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 - 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- E. 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 (610 mm) o.c. unless otherwise indicated.

- F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Accessories" Article.

3.13 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

- B. Placing Reinforcement: Comply with requirements in TMS 602.

- 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 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 (1524 mm).

3.14 DAMPPROOFING

- 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 (150 mm) over outside face of footing.

1. Extend dampproofing 12 inches (300 mm) 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- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

- C. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

- D. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or primer and one trowel coat at not less than 5 gal./100 sq. ft. (2 L/sq. m).

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: If required, Owner will engage a qualified testing agency to perform tests and inspections. 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 will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Section 1705.4 of the 2018 International Building Code (IBC)
- C. Testing Frequency: Verify with local code authorities
- D. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.
- E. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

3.16 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3.2 mm per 305 mm). Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.17 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.18 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 1. Crush masonry waste to less than 4 inches (102 mm) in each dimension.
 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
 3. Do not dispose of masonry waste as fill within 18 inches (457 mm) of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. 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 042000

SECTION 047200 - CAST STONE MASONRY

1.1 SUMMARY

A. Section Includes:

1. Wall Caps

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

C. Samples:

1. For each color and texture of cast stone required, 4 inches (100 mm) square in size.
2. For colored mortar.

1.3 INFORMATIONAL SUBMITTALS

A. Material test reports.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.

1. Provide test reports based on testing within previous two years.

C. Submit description of manufacturing process (wet cast, machine cast, or vibrant dry tamp).

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by CSI.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship cast-stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast-stone units if required, using dollies with wood supports.
2. Store cast-stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

- C. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

A. MATERIAL LIMITATIONS

- 1. Source Limitations for Cast Stone: Obtain cast-stone units from single source from single manufacturer.
- 2. Source Limitations for Mortar Materials: Obtain cast-stone units from single source from single manufacturer.

2.2 CAST STONE UNITS

- A. Basis of Design Product: Provide Cast Stone products as manufactured by the following:
 - 1. Sun Precast Co., Inc.
Beaver Springs, PA 17812
www.sunprecast.com
(570) 658-8008
 - 2. Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable if approved in accordance with Section 012500 "Substitution Procedures."
- B. Cast Stone Units: Comply with ASTM C1364.
 - 1. Units are manufactured using the manufacturer's selected method.
 - 2. Trim units including copings wall caps.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.

D. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
 - b. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.

E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

F. Colors and Textures: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- B. Dowels: 1/2-inch- (12-mm-) diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.4 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
- B. Comply with ASTM C270, Proportion Specification.
 1. For setting mortar, use Type S.
 2. For pointing mortar, use Type N.
- C. Preblended dry mortar mix complying with ASTM C1714/C1714M and capable of producing mortar strength as indicated in ASTM C270.
 1. For setting mortar, use Type N.
 2. For pointing mortar, 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.

2.5 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C1364.

PART 3 - EXECUTION

3.1 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated in TMS 604.
- B. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."
- C. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Build concealed flashing into mortar joints as units are set.
 - 2. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
 - 3. Keep joints at shelf angles open to receive sealant.
- D. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- E. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- F. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- G. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.
- H. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.2 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated in TMS 604.
- B. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 ft. (3 mm in 3 m) maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 ft. (3 mm in 3 m) maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.

- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. Apply Sacrificial Coating per manufacturer's recommendations to all exposed surfaces. Provide test sample for Architect's inspection.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 - 1. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Threaded rods.

- B. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Mill test reports for structural-steel materials, including chemical and physical properties.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using ANSI/AISC 360.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

2.4 RODS

- A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
 1. Finish: Plain.
- B. Threaded Rods: ASTM A36/A36M.
 1. Finish: Plain.

2.5 PRIMER

- A. Steel Primer:
 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.8 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.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 3.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.

- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
 - 4. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 5. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. K-series/KCS-series steel joists.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Manufacturer certificates.
- C. Paint compatibility certificates.
- D. Mill Certificates: For each type of bolt.
- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to the requirements of this section and the Structural design, provide products by one of the following:
1. Vulcraft/ Nucor
 2. O'Donnell Metal Deck & Bar Joist
 3. New Millenium

2.2 STEEL JOISTS

- A. K-Series and KCS-Series Steel Joist: Manufactured steel joists of type indicated in accordance with "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
1. Steel Joist Substitutes: Manufacture in accordance with "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

2.3 PRIMERS

- A. Primer:
1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.4 STEEL JOIST ACCESSORIES

- A. Bridging:
1. Schematically indicated. Detail and fabricate in accordance with SJI's "Specifications." Furnish additional erection bridging if required for stability.
- B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.
1. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated on Drawings.
 2. Finish: Plain.
- C. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.

- B. Apply one coat of shop primer to joists and joist accessories.

PART 3 - EXECUTION

3.1 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 in accordance with SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds in accordance with AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Welding certificates.
2. Product Certificates: For each type of steel deck.

B. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that power-actuated mechanical fasteners comply with requirements.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding code:

- a. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
 - 2. Color: Gray top surface with white underside.
 - 3. Profile Depth: As indicated.
 - 4. Design Uncoated-Steel Thickness: As indicated.
 - 5. Span Condition: As indicated.
 - 6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth.

- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Galvanizing Repair Paint: ASTM A780/A780M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.2 INSTALLATION OF FLOOR DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
 - 2. Weld Spacing:
 - a. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches (300 mm) apart with at least one weld or fastener at each corner.
- F. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- G. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
- H. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.3 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 - 2. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing wall framing.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cold-formed steel framing materials.
 - 2. Non-load-bearing wall framing.
 - 3. Single deflection track.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CEMCO; California Expanded Metal Products Co.
 - 2. ClarkDietrich.
 - 3. Marino\WARE.

2.2 PERFORMANCE REQUIREMENTS

- A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI S240 for conditions indicated.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: ST33H (ST230H).
- C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 33 (230).

2.4 NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
 - 2. Flange Width: 1-5/8 inches (41 mm) minimum.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.
- C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Uses: Securing cold-formed steel framing to structure.
 - 2. Type: Torque-controlled expansion anchor.
 - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.7 MISCELLANEOUS MATERIALS

- A. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. 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, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- D. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at exterior stud or joist locations.

3.2 INSTALLATION, GENERAL

- A. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- D. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- F. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 INSTALLATION OF NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches (406 mm) or As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches (450 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation 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 are not to exceed minimum fastening requirements of sheathing or other finishing materials.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous framing and supports.
 - 2. Shelf angles.
 - 3. Miscellaneous steel trim.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.
 - 2. Anchor bolts.
 - 3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
 - 2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Fasteners.
 - 3. Shop primers.
 - 4. Shrinkage-resisting grout.
 - 5. Slotted channel framing.
 - 6. Abrasive metal nosings, treads, and thresholds.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Miscellaneous steel trim including steel angle corner guards steel edgings and loading-dock edge angles.
4. Loose steel lintels.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- D. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

- E. Rolled-Stainless Steel Floor Plate: ASTM A793.
- F. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- G. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- H. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- I. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.
- J. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- K. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum stainless steel or nickel silver.
 - 2. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and

compatible with paints specified to be used over it.

- E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

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

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
 - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
 - 2. Unless otherwise indicated, provide 1/2-inch baseplates with four 5/8-inch anchor bolts and 1/4-inch top plates.
- D. Galvanize miscellaneous framing and supports where indicated.

2.7 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. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.

2.8 MISCELLANEOUS STEEL TRIM

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

- C. Galvanize and prime exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.9 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 bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

2.10 LOOSE STEEL LINTELS

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

2.11 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099113 "Exterior Painting" primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is indicated.

- D. 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.

2.13 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

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.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported,

including manufacturers' written instructions and requirements indicated on Shop Drawings.

- B. Anchor supports for operable partitions overhead doors and overhead grilles securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to existing construction with expansion anchors.
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF SHELF ANGLES

- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

3.4 INSTALLATION OF MISCELLANEOUS STEEL TRIM

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.5 INSTALLATION OF LOOSE 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 shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum railings.
 - 2. Stainless steel railings.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for metal shapes and finishes.
 - 2. Section 079200 "Joint Sealants" for exterior sealant around post bases.

1.2 COORDINATION

- 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.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Handrail brackets.
 - 3. Panel brackets.
 - 4. Mesh panel infills.
 - 5. Nonshrink, nonmetallic grout.
 - 6. Metal finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish.
- D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

- a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- b. Infill load and other loads need not be assumed to act concurrently.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 ALUMINUM RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. 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.
- C. Extruded Bars and Tubing: **ASTM B221** (**ASTM B221M**), Alloy 6063-T5/T52.
- D. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- E. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
- F. Plate and Sheet: **ASTM B209** (**ASTM B209M**), Alloy 6061-T6.
- G. Die and Hand Forgings: **ASTM B247** (**ASTM B247M**), Alloy 6061-T6.
- H. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.4 STAINLESS STEEL RAILINGS – **TYPICAL ALL EXTERIOR LOCATIONS**

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: ASTM A554, Grade MT 304.
- C. Pipe: ASTM A312/A312M, [Grade TP 304] [Grade TP 316L].
- D. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.
- E. Plate and Sheet: ASTM A240/A240M or ASTM A666, Type 304.
- F. Expanded Metal Infill Panels: ASTM F1267, Type I (expanded), Class 3 (corrosion-resistant steel), made from stainless steel sheet, ASTM A240/A240M or ASTM A666, Type 304.
- G. Style Designation: 1-1/2 number 10
- H. Design: See Drawings.

2.5 FASTENERS

- A. Fastener Materials:
 - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.

2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
 3. Aluminum & Stainless Steel Railing Components: Type 304 stainless steel fasteners.
 4. Finish exposed fasteners to match appearance, including color and texture, of railings.
- 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 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 exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.6 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Match railing material, minimum 1-1/2 inches (38.1 mm) from face of railing to face of wall.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
1. For aluminum and stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." OR Section 099123 "Interior Painting." as applicable to location.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.
- H. Skateboard Deterrents at exterior tube railings sloped greater than 1:20:
 - 1. Locations: Where indicated in Drawings.
 - 2. Basis of Design Product: Subject to compliance with requirements, provide Grind to a Halt, Inc; "Round Handrail Minder," or a comparable product by one of the following:
 - a. Skatestoppers, Inc. (Intelliccept), Model HR
 - 3. Material: Anodized Aluminum
 - 4. Size: To match outside diameter of tubular railing.
 - 5. Spacing: 48-inches maximum
 - 6. Fasteners: Tamper-resistant, Stainless Steel

2.7 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. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately **1/32 inch (1 mm)** unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.

- H. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam-type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.
- I. 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 EXTERIOR exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.
 - 5. At INTERIOR exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.
- J. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- K. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.
- L. Form changes in direction as follows:
 - 1. As detailed.
 - 2. By bending.
- M. 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.
- N. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- O. 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 (6 mm)** or less.
- P. 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.
- Q. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.

2. Coordinate anchorage devices with supporting structure.
- R. For railing posts set in concrete, provide stainless steel sleeves not less than **6 inches (150 mm)** long with inside dimensions not less than **1/2 inch (13 mm)** greater than outside dimensions of post, with metal plate forming bottom closure.
- S. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.
 1. Provide socket covers designed and fabricated to resist being dislodged.
 2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- T. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 ALUMINUM FINISHES

- A. 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 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.
- B. Mill Finish: AA-M12, nonspecular as fabricated.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31.
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.
- E. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and 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.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 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. When polishing is completed, passivate and rinse surfaces.
 2. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Stainless Steel Finishes:

1. Polished and Buffed Finish: 320-grit finish followed by buffing to match Architect's sample.

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 are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 1. Fit exposed connections together to form tight, hairline joints.
 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 5. Set posts plumb within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.
 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet (6 mm in 3.5 m)**.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. 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.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than **5 inches (125 mm)** deep and **3/4 inch (20 mm)** larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with **1/8-inch (3-mm)** buildup, sloped away from post.
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.
 - 2. For aluminum railings, attach posts as indicated, using fittings designed and engineered for this purpose.
 - 3. For stainless steel railings, weld flanges to post and bolt to supporting surfaces.
- D. Install removable railing sections, where indicated, in slip-fit stainless steel sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with **1-1/2-inch (38-mm)** clearance from inside face of handrail and finished wall surface.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 2. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 3. For hollow masonry anchorage, use toggle bolts.
 - 4. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 5. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
- B. Install railing gates level, plumb, and secure for full opening without interference.
 - 1. Attach hardware using tamper-resistant or concealed means.
 - 2. Adjust hardware for smooth operation.

3.6 REPAIR

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" or Section 099123 "Interior Painting" as applicable.

3.7 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.8 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 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preserved-treated lumber.
3. Fire-retardant-treated lumber.
4. Dimension lumber framing.
5. Miscellaneous lumber.
6. Plywood backing panels.
7. Rooftop equipment bases and support curbs.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.

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. Include data for wood-preserved 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 in accordance with ASTM D5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

- ##### A.
- Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products 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

- ##### A.
- Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. 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 wood products.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- ##### A.
- Preservative Treatment by Pressure Process: AWP A U1, Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. 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 that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment is not to promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

- E. Application: Treat items indicated on Drawings and as required by the Authority Having Jurisdiction.

2.4 DIMENSIONAL LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions by Grade: Construction, Stud, or No. 3 grade.
 - 1. Application: All interior partitions.
- B. Load-Bearing Partitions by Grade: Construction or No. 2 grade.
 - 1. Application: Exterior walls and interior load-bearing partitions.
- C. Ceiling Joists: Construction or No. 2 grade.
- D. Joists, Rafters, and Other Framing by Grade: Construction or No. 2 grade.

2.5 MISCELLANEOUS LUMBER

- E. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
 - 7. Utility shelving.
- F. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- G. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 3 grade; SPIB.
 - 2. Eastern softwoods; No. 3 Common grade; NeLMA.
 - 3. Northern species; No. 3 Common grade; NLGA.
- H. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- I. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- J. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

- K. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, C-C Plugged, in thickness indicated or, if not indicated, not less than **3/4-inch (19-mm)** nominal thickness.

2.7 FASTENERS

- L. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than **1-1/2 inches (38 mm)** into wood substrate.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.
- M. Nails, Brads, and Staples: ASTM F1667.
- N. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- O. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

2.8 MISCELLANEOUS MATERIALS

- P. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **0.025 inch (0.6 mm)**.
- Q. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- R. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

- D. 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 (406 mm)** o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than **96 inches (2438 mm)** o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than **96 inches (2438 mm)** o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and **2-inch nominal (38-mm actual)** thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than **100 sq. ft. (9.3 sq. m)** and to solidly fill space below partitions.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
- L. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.
- M. 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 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for attaching 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

3.3 INSTALLATION OF WOOD FURRING

- 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 Plywood or Hardboard Paneling: Install **1-by-3-inch nominal- (19-by-63-mm actual-)** size furring vertically at **24 inches (610 mm)** o.c.
- C. Furring to Receive Gypsum Board or Plaster Lath: Install **1-by-2-inch nominal- (19-by-38-mm actual-)** size furring vertically at **16 inches (406 mm)** o.c.

3.4 INSTALLATION OF WALL AND PARTITION FRAMING

- A. General: Provide single bottom plate and double top plates using members of **2-inch nominal (38-mm actual)** thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction unless otherwise indicated.
 - 1. Provide continuous horizontal blocking at midheight of partitions more than **96 inches (2438 mm)** high, using members of **2-inch nominal (38-mm actual)** thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than **4-inch nominal (89-mm actual)** depth for openings **48 inches (1200 mm)** and less in width, **6-inch nominal (140-mm actual)** depth for openings **48 to 72 inches (1200 to 1800 mm)** in width, **8-inch nominal (184-mm actual)** depth for openings **72 to 120 inches (1800 to 3000 mm)** in width, and not less than **10-inch nominal (235-mm actual)** depth for openings **10 to 12 feet (3 to 3.6 m)** in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings **60 inches (1500 mm)** and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

3.5 INSTALLATION OF FLOOR JOIST FRAMING

- A. General: Install floor joists with crown edge up and support ends of each member with not less than **1-1/2 inches (38 mm)** of bearing on wood or metal, or **3 inches (76 mm)** on masonry. Attach floor joists as follows:
 - 1. Where supported on wood members, by using metal framing anchors.
 - 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Fire Cuts: At joists built into masonry, bevel cut ends **3 inches (76 mm)** and do not embed more than **4 inches (102 mm)**.
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds **48 inches (1200 mm)**.
- D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than **2 inches (50 mm)** from top or bottom.
- E. Provide solid blocking of **2-inch nominal (38-mm actual)** thickness by depth of joist at ends of joists unless nailed to header or band.
- F. Lap members framing from opposite sides of beams, girders, or partitions not less than **4 inches (102 mm)** or securely tie opposing members together. Provide solid blocking of **2-inch nominal (38-mm actual)** thickness by depth of joist over supports.
- G. Anchor members paralleling masonry with **1/4-by-1-1/4-inch (6.4-by-32-mm)** metal strap anchors spaced not more than **96 inches (2438 mm)** o.c., extending over and fastening to three joists. Embed anchors at least **4 inches (102 mm)** into grouted masonry with ends bent at right angles and extending **4 inches (102 mm)** beyond bend.
- H. Provide solid blocking between joists under jamb studs for openings.
- I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
 - 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- J. Provide bridging of type indicated below, at intervals of **96 inches (2438 mm)** o.c., between joists.
 - 1. Diagonal wood bridging formed from bevel-cut, **1-by-3-inch nominal- (19-by-64-mm actual-)** size lumber, double-crossed and nailed at both ends to joists.
 - 2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.6 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING

- A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

- B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 - 1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 - 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.7 PROTECTION

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

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plywood Subflooring and Underlayment

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 PRESERVATIVE-TREATED, FIRE-RETARDANT-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.
- D. See paragraph 2.3 for Fire-Retardant-Treatment requirements.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

2.4 SUBFLOORING

- A. Plywood Subflooring: Either DOC PS 1 or DOC PS 2, Exterior, Structural I single-floor panels or sheathing.
 - 1. Type and Thickness: As noted in drawings.
- B. Plywood Underlayment: Either DOC PS 1, Interior, Underlayment.
 - 1. Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Coordinate wall 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.

3.2 PLYWOOD INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Subfloor Sheathing:
 - a. Glue and nail to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels **1/8 inch (3 mm)** apart at edges and ends.

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim and mouldings.
2. Shelving and clothes rods.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 064214 "Stile and Rail Wood Paneling" for interior wainscot and trim.
3. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.
4. Section 123216 "Cabinets and Casework" for casework and cabinetry.
5. Section 123661.19 "Quartz Agglomerate Countertops" for countertops.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.
- C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Interior trim.
2. Paneling.
3. Shelving and clothes rods.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors 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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

C. Samples: For each exposed product and for each color and texture specified.

- D. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
- E. Samples for Verification:
 - 1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
 - 2. For foam-plastic moldings, with half of exposed surface finished; 50 sq. in. (300 sq. cm).
 - 3. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
- F. Shop Drawings:
 - 1. Include the following:
 - a. Dimensioned plans, elevations, and sections.
 - b. Attachment details.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
- G. Samples: For each exposed product and for each shop-applied color and finish specified.
 - 1. Size:
 - a. Panel Products: 12 inches by 12 inches (300 mm by 300 mm).
 - b. Lumber Products: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long for each species and cut, finished on one side and one edge.

1.4 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.
 - 1. Shop Certification: AWI's Quality Certification Program accredited participant.
- B. Installer Qualifications: Quality Certification Program accredited participant.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of interior panel and trim assemblies.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
 2. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber, mark grade stamp on end or back of each piece.
- B. Softwood Plywood: DOC PS 1.
- C. MDF: ANSI A208.2, Grade 130.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with ISO 4586-3, Grade VGS.
1. Color: As selected by Architect from manufacturer's full range.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC1.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the ALSC's Board of Review.
 - a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
 - a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
7. Application: All interior lumber and plywood.

2.3 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade:
 - a. Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Superior or C & Btr finish.
2. Maximum Moisture Content: 15 percent.
3. Finger Jointing: Allowed.
4. Face Surface: Surfaced (smooth).

B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Red oak or White maple; NHLA Clear A Finish.
2. Maximum Moisture Content: 13 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Use for lumber trim wider than 6 inches (150 mm).
5. Face Surface: Surfaced (smooth).
6. Matching: Selected for compatible grain and color.

C. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade:
 - a. Eastern white pine; NeLMA or NLGA D Select.
 - b. Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Superior or C & Btr finish.
2. Maximum Moisture Content for Softwoods: 15 percent.

3. Maximum Moisture Content for Hardwoods: 13 percent.
4. Finger Jointing: Allowed.
5. Face Surface: Surfaced (smooth).
6. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

2.4 SHELVING AND CLOTHES RODS

- A. Shelving: Exposed, Closet, or Utility shelving, made from one of the following materials, 3/4 inch (19 mm) thick:
 1. Wood boards as specified above for lumber trim for opaque and transparent finishes.
- B. Shelf Cleats: 3/4-by-5-1/2-inch (19-by-140-mm) boards, hardwood lumber trim for transparent finish.
- C. Shelf Brackets with and without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A&M Hardware, Inc.
 - b. Centerline Brackets; Centerline Steel, LLC.
 - c. EPCO, Engineered Products Co.
- D. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel.
- E. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.
- F. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; powder-coat-finished steel.
- G. Metal Clothes Rods: 1-5/16-inch- (33-mm-) diameter, stainless steel tubes.
- H. Metal Rod Flanges: Stainless steel.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- C. Installation Adhesive for Foam-Plastic Moldings: Product recommended for indicated use by foam-plastic molding manufacturer.
- D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

2.6 FABRICATION

- A. Back out or kerf backs of the following members, except those with ends exposed in finished work:
 - 1. Interior standing and running trim, except shoe and crown molds.
 - 2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 INSTALLATION OF INTERIOR TRIM

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
 - 1. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 - 7. Install trim after gypsum-board joint finishing operations are completed.
 - 8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
 - 9. Fasten to prevent movement or warping.
 - 10. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 INSTALLATION OF SHELVING AND CLOTHES RODS

- A. Cut shelf cleats at ends of shelves about 1/2 inch (13 mm) less than width of shelves and sand exposed ends smooth.
 - 1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
 - 2. Space fasteners not more than 16 inches (400 mm) o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal (89 mm actual) in width and wider.
 - 3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
 - 4. Remove adhesive that is squeezed out after fastening shelf cleats in place.
- B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches (800 mm) o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches (300 mm) o.c.
- D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. and within 6 inches (150 mm) of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.
 - 1. Install shelves, fully seated on cleats, brackets, and supports.
 - 2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

- F. Install rod flanges for rods as indicated.
 - 1. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
 - 2. Install rods in rod flanges.

3.6 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements.
 - 1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

3.7 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces.
- B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.8 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 064214 - STILE AND RAIL WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stile and rail wood paneling for transparent finish.
2. Stile and rail wood paneling for opaque finish.
3. Wood furring, blocking, shims, and hanging strips for installing stile and rail wood paneling that are not concealed within other construction.
4. Shop finishing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For stile and rail wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Quality Standard Compliance Certificates:** AWI Quality Certification Program.

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.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

- B. Installer Qualifications:** Quality Certification Program accredited participant.

- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of interior panel and trim assemblies.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet-work 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 PANELING FABRICATORS

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling [and] [wood-veneer-faced architectural cabinets] [ornamental woodwork] [wood trim] [wood frames] [and] [wood doors faced with veneers from same flitches as paneling].

2.2 PANELING, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of stile and rail wood paneling (stile and rail wall surfacing) indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.

2.3 STILE AND RAIL WOOD PANELING FOR TRANSPARENT FINISH

- A. Grade: Custom.
- B. Wood Species: White oak, rift sawn/sliced.
- C. Stiles and Rails: At fabricator's option, stiles and rails may be either lumber or veneered construction with edges banded or with lumber moldings, as indicated, to conceal core and veneer joints.
- D. Panels: Flat panels.
- E. Insert Panels: Book and balance match face veneers within panels. No matching is required between adjacent panels; select and arrange panels for similarity of grain pattern and color between adjacent panels.

- F. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.

- 1. Outside Corner of Stile and Rail Paneling: Shop prepare using lock-mitered or mitered-and-splined construction. Assemble, sand, and glue in shop if site conditions permit.

2.4 STILE AND RAIL WOOD PANELING FOR OPAQUE FINISH

- A. Grade: Custom.
- B. Wood Species: Any closed-grain hardwood.
- C. Stiles and Rails: Either solid lumber or particleboard, shop filled on face, with veneered or lumber-banded edges, at paneling fabricator's option.
- D. Flat Insert Panels: MDF or particleboard with shop-filled face.
- E. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.
 - 1. Outside Corner of Stile and Rail Paneling: Shop prepare using lock-mitered or mitered-and-splined construction. Assemble, sand, and glue in shop if site conditions permit.

2.5 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Wood Moisture Content: 5 to 10 percent.
- C. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
 - 1. MDF: ANSI A208.2, Grade 130.
 - 2. Particleboard: ANSI A208.1, Grade M-2.
 - 3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.6 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials 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.
 - 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.

2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.7 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.
- C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.8 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
- C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items.

2.9 SHOP FINISHING

- A. Finishing:
 1. Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished paneling specified to be field finished.
 1. See Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for material and application requirements.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
 1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.
- D. Transparent Finish:

1. Grade: Same as item to be finished.
2. Finish: System - 5, conversion varnish.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: Match approved sample for color.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D523.

E. Opaque Finish:

1. Grade: Same as item to be finished.
2. Finish: System - 5, conversion varnish.
3. Colors: Match Architect's samples.
4. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 INSTALLATION OF STILE AND RAIL WOOD PANELING

- A. Before installation, condition paneling to humidity conditions in installation areas.
- B. Grade: Install paneling to comply with quality standard grade of paneling to be installed.
- C. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches (3 mm in 2400 mm)**. Install with no more than **1/16 inch in 96-inch (1.6 mm in 2400-mm)** vertical cup or bow and **1/8 inch in 96-inch (3 mm in 2400-mm)** horizontal variation from a true plane.
- D. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor paneling to supporting substrate with blind nailing or adhesive.
 1. Do not use face fastening unless covered by trim.
- F. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.
- G. See [Section 099123 "Interior Painting" Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling.

END OF SECTION 064214

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic sheet wall paneling.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring for installing plastic paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Experience completing a minimum five projects of similar size, type, and complexity. Workers employed on this Project competent in techniques required by manufacturer for installation indicated.

B. Surface-Burning Characteristics: Determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction.

C. Meets USDA/FSIS requirements.

1.4 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.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace defective panels and components that fail in materials or workmanship under normal conditions of use within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Exposed fibers.

- b. Rust.
 - c. Rot.
 - d. Corrosion.
 - e. Structural surface cracks.
 - f. Painting or refinishing required with normal pigmentation and UV degradation excepted.
- 2. Warranty Period - Glass-Fiber-Reinforced Plastic Paneling: ONE year from date of Substantial Completion, and prorated for years TWO through TEN.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319. Panels are to be USDA accepted for incidental food contact.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. RFP1 & RFP2
 - 1) Crane Composites; DESIGNS, faced FRP
 - 2) Marlite, Inc.; Induro, HPL-faced FRP
- 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
- 3. Nominal Thickness: Not less than 0.075 inch (1.9 mm).
- 4. Wall Panel Size: As indicated on Drawings.
- 5. Surface Finish: Match Architect's Sample
- 6. Color (Pattern)
 - a. **FRP1 OPTION 1**
 - 1) Marlite, Inc. Standard Pebbled, White
 - b. **FRP1 OPTION 2**
 - 1) Crane Composites Glasbord Pebbled, White

2.3 ACCESSORIES

- A. Trim Accessories:
 - 1. Aluminum extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

- a. Color: White.
- B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- C. Adhesive: As recommended by plastic paneling manufacturer.
- D. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "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.
 - 1. Corners: Plumb and straight.
 - 2. Surfaces: Smooth, sound, and uniform.
 - 3. Nails or Screw Fasteners: Countersunk.
 - 4. Joints and Cracks: Filled flush and smooth with adjoining surfaces.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Ensure that all HVAC, electrical, plumbing, and similar work above the ceiling level has been completed.
- E. Condition panels by unpacking and placing in installation space before installation in accordance with manufacturer's written recommendations.
- F. 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 trim accessory locations for accurate installation.
 - 2. Locate trim accessories to allow clearance at panel edges in accordance with manufacturer's written instructions.

3.3 INSTALLATION

- A. Install plastic paneling in accordance with manufacturer's written instructions.
 - 1. Do all cutting with carbide-tipped saw blades or drill bits, or cut with snips.
 - 2. Install panels plumb, level, square, flat, and in proper alignment.
 - 3. Install panels to be water resistant and washable.
 - 4. Install panels with manufacturer's recommended gap for panel field and corner joints.
- B. Install panels in a full spread of adhesive.
 - 1. Apply sealant to fastener holes before installing fasteners.
- C. Install factory-laminated panels using concealed mounting splines in panel joints.
- D. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.
- E. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- F. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- G. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- H. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes penetrating water-repellant AND chloride-screen treatments for the following vertical and horizontal surfaces:
 - 1. Exterior concrete paving.
 - 2. Exterior clay brick paving.
 - 3. Exterior cast stone masonry.
 - 4. Exterior clay brick masonry.
 - 5. Polished cast-in-place concrete floors.
- B. Section includes penetrating water- AND color-enhancing treatments for the following vertical and horizontal surfaces:
 - 1. Manufactured stone veneer.

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 water repellent and substrate indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. PROSOCO, Inc.

2. Pecora Corporation.
3. W. R. Meadows, Inc.

2.2 PENETRATING WATER REPELLENTS

- A. Penetrating Low-VOC Silane Water Repellent and Chloride Shield: Clear, containing 40 percent or more active content of silane; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 600 g/L or less of VOCs.
 1. Applications:
 - a. Exterior cast stone masonry.
 - b. Exterior clay brick masonry.
 - c. Exterior concrete paving.
 - d. Exterior clay brick paving.
- B. Penetrating Low-VOC Silane Water Repellent and Chloride Screen: Clear, containing 100 percent active content of silane; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
 1. Applications:
 - a. Interior concrete floors.
- C. Penetrating Low-VOC Silane or Silane/Siloxane-Blend Water Repellent and Color Enhancer: Clear, containing 6 percent or more active content of silane and siloxane blend with 400 g/L or less of VOCs.
 1. Applications:
 - a. Manufactured stone veneer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 1. Verify that surfaces are clean and dry in accordance with water-repellent manufacturer's requirements. Check moisture content in representative locations by method recommended by manufacturer.
 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level in accordance with water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, in accordance with repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product in accordance with water-repellent manufacturer's written instructions.
- C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

- A. Apply coating of water repellent on surfaces to be treated using low-pressure spray to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL AND ACOUSTIC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board insulation.
 - 2. Polyisocyanurate foam-plastic board insulation.
 - 3. Glass-fiber blanket insulation.
 - 4. Acoustic Mineral-wool board insulation
 - 5. Acoustic Glass-fiber Blanket Insulation

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Extruded polystyrene foam-plastic board insulation.
 - 2. Polyisocyanurate foam-plastic board insulation.
 - 3. Glass-fiber blanket insulation.
 - 4. Acoustic Mineral-wool board insulation
 - 5. Acoustic Glass-fiber Blanket Insulation

1.3 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
 - 1. Sign, date, and post the certification in a conspicuous location on Project site.
- B. Product test reports.
- C. Research reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics – Non-fire-rated Construction: Maximum flame-spread and smoke-developed indexes less than 75 and 450 when tested in accordance with ASTM E84.
- B. Surface-Burning Characteristics – Fire-rated Construction: Maximum flame-spread and smoke-developed indexes less than 25 and 50 when tested in accordance with ASTM E84.
- C. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- D. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- E. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.
- F. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. Extruded Polystyrene Board Insulation (XPS), Type IV: ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DuPont de Nemours, Inc.
 - b. Owens Corning.
 - c. The Dow Chemical Company.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

- A. Polyisocyanurate Board Insulation, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DuPont de Nemours, Inc.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Rmax, Inc.
 - d. The Dow Chemical Company.

2.4 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Owens Corning.
- B. Glass-Fiber Blanket Insulation, Kraft Faced: ASTM C665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed; SAINT-GOBAIN.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Owens Corning.

2.5 ACOUSTIC MINERAL-WOOL BOARD INSULATION

- A. Mineral-Wool Board Insulation, Types IA and IB, Faced: ASTM C612, Types IA and IB; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Owens Corning.
 2. Nominal Density: 6 lb/cu. ft. (96 kg/cu. m).

2.6 ACOUSTIC GLASS-FIBER BLANKET INSULATION

- A. Acoustic Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Owens Corning.
 2. Nominal Density: 2.5 lb/cu. ft. (107 kg/cu. m).

2.7 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
- D. Foam Board Sealing Tape: Product compatible with XPS board insulation, and with demonstrated capability to bond insulation securely to adjacent boards or substrates without damaging insulation and substrates.
- E. Foil-faced Tape: Product compatible with foil-faced foam- and mineral wool-board insulation, and with demonstrated capability to bond insulation securely to adjacent boards or substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- F. Tape board seams with compatible tape.

3.2 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Tape seams.
- C. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.
- D. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 5. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

- a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- 6. 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.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 INSTALLATION OF BOARD ACOUSTIC INSULATION IN CEILING PLENUM

- A. Compress boards vertically and horizontally to minimize gaps.
- B. Install with faced side to interior/private side of partition.
- C. Cut and patch boards around gaps.
- D. Butt panels together for tight fit.
- E. Tape seams on faced side.
- F. Anchor Installation: Anchor boards to substrate above with sheet metal screws and insulation washers at maximum 18 inches on center.
- G. Fit boards tightly to top of ceiling panels or substrate below.

END OF SECTION 072100

SECTION 072715 - NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Self-adhering, vapor-retarding, nonbituminous sheet air barriers for low slope roofing.
- B. Related Sections:
 - 1. Section 053100 "Steel Decking" for roof deck.
 - 2. Section 075416 "Keytone Ethylene Ester (KEE) Roofing" for roof assembly materials.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of nonbituminous self-adhering sheet air barrier.
- B. Product test reports.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier. Air-barrier assemblies to 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. (0.2 L/s x sq. m of surface area at 75 Pa), when tested in accordance with ASTM E2357.

2.2 NONBITUMINOUS SHEET AIR BARRIER

- A. Vapor-Retarding Nonbituminous Sheet: Minimum 10-mil- (0.25-mm-) thick, self-adhering sheet consisting of 5 mils (0.13 mm) of air-barrier film and a 5-mil- (0.13-mm-) thick, acrylic adhesive with release liner on adhesive side.
 - 1. Manufacturers: Subject to compliance with this Section, provide Air/Vapor Barrier products by one of the following:
 - a. GAF
 - b. Carlisle/Syntec
 - c. FiberTite Roof Systems
 - 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
 - b. Puncture Resistance: Minimum 60 lbf (180 N; ASTM E154/E154M.
 - c. Vapor Permeance: Maximum .03 perm (1.7 ng/Pa x s x sq. m; ASTM E96/E96M, Desiccant Method.
 - d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested in accordance with ASTM D4541 as modified by ABAA.
 - e. UV Resistance: Can be exposed to sunlight for 150 days in accordance with manufacturer's written instructions.

2.3 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination 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.
- B. Substrate: Provide roof substrate board over steel decking if barrier cannot be applied directly to steel roof deck.
- C. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with 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 membrane.
- 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 discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.2 INSTALLATION

- A. Install materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
 - 1. Apply sheets in a shingled manner to shed water.
 - 2. Roll sheets firmly to enhance adhesion to substrate.
- D. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
- E. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.
- F. Do not cover air barrier until it has been inspected by roofing inspector.
- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

- A. Air barriers will be considered defective if they do not pass inspections.
 - 1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.

- B. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- C. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.

END OF SECTION 072715

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vapor-retarding, 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to 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 to 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 Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75 Pa) pressure difference; ASTM E2178.
- C. Ultimate Elongation: Minimum 500 percent; ASTM D412, Die C.
- D. UV Resistance: Can be exposed to sunlight for 120 days in accordance with manufacturer's written instructions.

2.2 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

- A. High-Build, Vapor-Retarding Air Barrier Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide W. R. Meadows, Inc ; Air-Shield LSR. or a comparable product by one of the following:
 - a. Henry Company; a Carlisle company.
 - b. Tremco Commercial Sealants and Waterproofing, part of Tremco CPG.
- B. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E96/E96M,.

2.3 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 in accordance with 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 discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.2 INSTALLATION

- A. Install materials in accordance with 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 (75 mm) 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.
- B. 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.
- C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames.
- D. 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 (150 mm) beyond repaired areas in strip direction.
- E. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
 - 1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness not less than 40 mils (1.0 mm), applied in.
- F. 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, in accordance with manufacturer's written instructions.
- B. Remove masking materials after installation.

END OF SECTION 072726

SECTION 075416 - KETONE ETHYLENE ESTER (KEE) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ketone ethylene ester (KEE) roofing system.
2. Accessory roofing materials including Substrate Board.
3. Roof insulation.
4. Insulation accessories and cover board.
5. Walkways.

B. Related Sections:

1. Section 061000 "Miscellaneous Rough Carpentry" for wood blocking, curbs, nailers and cants.
2. Section 072700 "Air and Vapor Barriers"
3. Section 076200 "Sheet Metal Flashing and Trim" for shop-formed sheet metal items including roof drainage system items, roof penetration flashings, base and counterflashings and reglets, and formed copings and roof edge metal items.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

- A. Roofing Terminology:** Refer to ASTM D1079 "Standard Terminology Relating to Roofing and Waterproofing" and glossary in applicable edition of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" for definition of terms related to roofing work in this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference:** Conduct conference at Project site with representative of roofing manufacturer and installers.

1.4 ACTION SUBMITTALS

- A. Product Data:** For each type of product.

- B. Shop Drawings:** Include plans, elevations, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.

4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

C. Samples: For the following products:

1. Roof membrane and flashing, of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Inspection Reports: Reports of Roofing Inspector. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.

D. Field quality-control reports.

E. Unexecuted sample copies of warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Executed copies of warranties.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of five years' experience installing products comparable to those specified, able to communicate verbally with Contractor,

Architect, and employees, and qualified by the manufacturer to install manufacturer's product and furnish warranty of type specified.

2. Manufacturer Qualifications: Approved manufacturer listed in this Section, UL listed for roofing systems comparable to that specified for this Project, with minimum five years' experience in manufacture of thermoplastic roof membrane products in successful use in similar applications.
3. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
 - a. An authorized full-time technical employee of the manufacturer.
4. Manufacturer's Installation Instructions: Obtain and maintain on-site access to manufacturer's written recommendations and instructions for installation of products.

1.8 WARRANTY

- A. Manufacturer's Warranty: Roof System Manufacturer's standard form in which Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within warranty period, as follows.
 1. Form of Warranty: Manufacturer's standard warranty form.
 2. Scope of Warranty: Work of this Section and including sheet metal details and termination details installed by the roof system Installer and approved by the Roof System Manufacturer.
 3. Warranty Period: 30 years from date of completion.
- B. Manufacturer Inspection Services: By manufacturer's technical representative, to report maintenance responsibilities to Owner necessary for preservation of Owner's warranty rights. The cost of manufacturer's inspections is included in the Contract Sum.
 1. Inspections to occur in following years: 2, 5, 10, 15, 20 & 25 following completion.
- C. Installer Warranty: Installer's warranty signed by Installer, as follows.
 1. Form of Warranty: Form acceptable to Roofing Manufacturer and Owner.
 2. Scope of Warranty: Work of this Section.
 3. Warranty Period: 2 years from date of completion.

1.9 PRODUCTS DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the requirements of this section, provide products by one of the following:
 - 1. Carlisle SynTec Systems; P.O. Box 7000, Carlisle, PA 17013; (800) 479-6832; www.carlisesyntec.com
 - 2. Elevate Roofing; Nashville, TN; <http://www.holcimelevate.com>
 - 3. FiberTite Roofing; Seaman Corporation, 1000 Venture Blvd., Wooster, OH 22691; (800) 927-8578; www.fibertite.com
 - 4. Tremco CPG Inc; Beachwood, OH, (800) 562-2728; www.tremcoroofing.com
- B. Source Limitations: Obtain components for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 10,000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency in accordance with ANSI/FM 4474, UL 580, or UL 1897, and to resist uplift pressures calculated in accordance with ASCE-7 and applicable code.
- C. Flashings and Fastening: Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:
 1. FM Global 1-49: Loss Prevention Data Sheet for Perimeter Flashings.
 2. FM Global 1-29: Loss Prevention Data Sheet for Above Deck Roof Components.
 3. NRCA Roofing Manual (Sixth Edition) for construction details and recommendations.
 4. SMACNA Architectural Sheet Metal Manual (Seventh Edition) for construction details.
- D. Exterior Fire-Test Exposure: ASTM E108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.
- F. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.
- G. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

2.3 KETONE ETHYLENE ESTER (KEE) ROOFING

- A. KEE Sheet: ASTM D6754/D6754M, fabric reinforced and fabric backed.
 1. Ketone Ethylene Ester (KEE) Content: Not less than 50 percent by weight of the polymer content of the sheet when tested in accordance with ASTM D8154.
 2. Thickness: 80 mils (2 mm), nominal, subject to warranty requirements.
 3. Exposed Face Color: To be selected from manufacturer's available non-custom color options.

2.4 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as KEE sheet.

- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard
- E. Slip Sheet: Manufacturer's standard, of thickness required for application.
- F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch (25 mm wide by 1.3 mm) thick, prepunched.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.
- J. Joint Sealant: Elastomeric joint sealant compatible with roofing materials, with movement capability appropriate for application.
 - 1. Joint Sealant, Polyurethane: ASTM C920, Type S, Grade NS, Class 50 single-component moisture curing sealant, formulated for compatibility and use in dynamic and static joints; paintable.

2.5 SUBSTRATE BOARD

- A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum substrate.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. National Gypsum Company.
 - c. USG Corporation.
 - 2. Thickness: As specified in drawings.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.6 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1 with felt or glass-fiber mat facer on both major surfaces.
 - 1. Compressive Strength, ASTM D1621: Grade 2: 20 psi (138 kPa).
 - 2. Conditioned Thermal Resistance at 75 deg. F (24 deg. C): 5.8 per inch, minimum.
- B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:
 - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.7 INSULATION ACCESSORIES AND COVER BOARD

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
- C. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, water-resistant gypsum board.
 1. Thickness: As specified in drawings.
- D. Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
- E. Wood Cant Strips: Comply with requirements in Division 06 rough carpentry Section.
- F. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
- G. Substrate Joint Tape: 6- or 8-inch- (150- or 200-mm-) wide, coated, glass fiber.

2.8 ASPHALT MATERIALS

- A. Hot-Applied Asphalt Adhesive: ASTM D312/D312M, Type III or Type IV.
 1. Softening Point, min/max, ASTM D36: 215–225 deg. F (100–105 deg. C).
 2. Ductility at 77 deg. F, (25 deg. C) minimum, ASTM D113: 1.5 cm.
 3. Penetration at 77 deg. F (25 deg. C), min/max, ASTM D5: 15–25 dmm.

2.9 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.
 1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
 2. Color: As selected by Architect from manufacturers standard options.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 - 2. Steel Roof Deck:
 - a. Verify that deck is securely fastened and properly supported with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Perform fastener-pullout tests in accordance with roof system manufacturer's written instructions.
 - 1. Submit test result within 24 hours of performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.
 - 2. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
 - 3. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. **Installer shall verify all system and installation requirements with roofing manufacturer to meet specified warranty.**
- B. Install roofing system in accordance with roofing system manufacturer's written instructions, listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- D. Coordinate installation and transition of roofing system component serving as an air and vapor barrier with air and vapor barrier specified under Section 072700 "Air and Vapor Barriers."
- E. Install wood cants, blocking, curbs, and nailers in accordance with requirements of Section 061000 "Miscellaneous Rough Carpentry."

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.
 - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
 - a. Locate end joints over crests of steel roof deck.
 - 2. Tightly butt substrate boards together.
 - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 4. Loosely lay substrate board over roof deck.

3.5 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 - 1. Install base layer of insulation with end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.
 - a. Locate end joints over crests of decking if no substrate board is present.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
 - a. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

- c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
- d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
- e. Trim insulation so that water flow is unrestricted.
- f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
- g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- h. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1) Prime substrate with primer as recommended by manufacturer and allow to dry.
 - 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
 - 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 - 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 - 4. Adhere cover board to substrate using adhesive in accordance with SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions. Unroll roof membrane and allow to relax before installing.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates in accordance with roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 INSTALLATION OF WALKWAYS

- A. Flexible Walkways: Install walkway products in accordance with manufacturer's written instructions.
 - 1. Install flexible walkways at the following locations:
 - a. Perimeter of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof access point and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - f. As required by roof membrane manufacturer's warranty requirements.
 - 2. Provide 6-inch (76-mm) clearance between adjoining pads.
 - 3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive in accordance with roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075416

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copings.
 - 2. Roof-edge specialties.
 - 3. Roof-edge drainage systems.
 - 4. Reglets and counterflashings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roof specialties.
 - 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
- C. Samples: For each type of roof specialty and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For tests performed by a qualified testing agency.
- B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

1.6 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Sections:
 - 1. 075416 – Ketone Ethylene Ester (KEE) Roofing

- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested in accordance with SPRI ES-1 and capable of resisting the following design pressures:
 - 1. Design Pressure: 13 lbs/sf
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
 - 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. ATAS International, Inc.
 - b. Metal-Era, Inc.
 - 2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.040 inch (1.02 mm) thick.
 - a. Surface: Smooth, flat finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 - 3. Corners: Factory mitered and continuously welded.

4. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.
 - a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.
 - b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.3 ROOF-EDGE SPECIALTIES

- A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of snap-on compression-clamped metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed galvanized-steel sheet cant, 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.
 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. ATAS International, Inc.
 - b. Metal-Era, Inc.
 2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.040 inch (1.02 mm) thick.
 - a. Surface: Smooth, flat finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 3. Corners: Factory mitered and continuously welded.
 4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
 5. Fascia Accessories: Fascia extenders with continuous hold-down cleats.
- B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.
 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. ATAS International, Inc.
 - b. EXCEPTIONAL Metals.
 - c. Metal-Era, Inc.
 2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.040 inch (1.02 mm) thick.
 - a. Surface: Smooth, flat finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 3. Corners: Factory mitered and continuously welded.
 4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
 5. Receiver: Manufacturer's standard material and thickness.

1. Fascia Accessories: Fascia extenders with continuous hold-down cleats.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

- 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. ATAS International, Inc.
 2. EXCEPTIONAL Metals.
 3. Metal-Era, Inc.
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
 1. Aluminum Sheet: 0.040 inch (1.02 mm) thick.
 2. Gutter Profile: Style F in accordance with SMACNA's "Architectural Sheet Metal Manual."
 3. Corners: Factory mitered and soldered.
 4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
 5. Gutter Accessories: Wire ball downspout strainer and flat ends.
- C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
 1. Formed Aluminum: 0.040 inch (1.02 mm) thick.
- D. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.
 1. Formed Aluminum: 0.032 inch (0.81 mm) thick.
- E. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout.
 1. Formed Aluminum: 0.032 inch (0.81 mm) thick.
- F. Aluminum Finish: Two-coat fluoropolymer.
 1. Color: As selected by Architect from manufacturer's full range.

2.5 REGLETS AND COUNTERFLASHINGS

- 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. ATAS International, Inc.
 2. EXCEPTIONAL Metals.
 3. Metal-Era, Inc.
- B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Formed Aluminum: 0.024 inch (0.61 mm) thick.
 2. Corners: Factory mitered and continuously welded.
 3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
- C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
1. Formed Aluminum: 0.024 inch (0.61 mm) thick.
- D. Accessories:
1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
 2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- E. Aluminum Finish: Two-coat fluoropolymer.
1. Color: As selected by Architect from manufacturer's full range.

2.6 MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

2.7 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. 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. ATAS International, Inc.
 - b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - c. Henry Company; a Carlisle company.
 2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F (116 deg C).
 3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C).

- B. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.8 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
 - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
 - 2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329.
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.9 FINISHES

- A. Coil-Coated Aluminum Sheet Finishes:
 - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply continuously under copings roof-edge specialties and reglets and counterflashings.
 - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

- B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.2 INSTALLATION, GENERAL

- A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
 - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 - 4. Torch cutting of roof specialties is not permitted.
 - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
 - 1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
 - 2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.3 INSTALLATION OF COPINGS

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
 - 1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.4 INSTALLATION OF ROOF-EDGE SPECIALITIES

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

- A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches (610 mm) apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion-joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.
 - 1. Provide elbows at base of downspouts at grade to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- D. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
- E. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below scupper or gutter discharge.

3.6 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Embedded Reglets: See Section 042000 "Unit Masonry" for installation of reglets.
- B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

- C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

- A. Clean and neutralize flux materials. Clean off excess solder and sealants.
- B. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

SECTION 078413 - PENETRATION AND JOINT 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. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.
 - 4. Joints in or between fire-resistance-rated constructions.
 - 5. Joints in smoke barriers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site among all Primes to coordinate vendors and systems.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 Delegated Design Submission:

- A. Lead Prime Contractor to submit complete firestopping system sheets for ALL penetrations and headwall joints in rated assemblies as a shop drawing to the Architect. Submission to be reviewed and approved by the Authority Having Jurisdiction prior to any firestopping work being performed.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
 - 1) UL in its online directory "Product iQ."
 - 2) Intertek Group in its "Directory of Building Products."
 - 3) FM Approvals in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work are:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. NUCO Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, 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 system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.

- G. 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.
- H. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- K. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls to accept standard accessories.
- L. Thermal Wrap: Flexible protective wrap tested and listed for up to 2-hour fire ratings in accordance with ASTM E814/UL 1479 for membrane penetrations or ASTM E1725/UL 1724 for thermal barrier and circuit integrity protection.
- M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.
- N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.
- O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.
- P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use around rectangular steel HVAC ducts without fire dampers.
- Q. Firestop Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.
- R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch (13 mm) diameter.
- S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.
- T. Endothermic Wrap: Flexible, insulating, fire-resistant, endothermic wrap for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system 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.

2.5 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
 - 1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
 - 2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
 - 3. Provide firestop products that do not contain ethylene glycol.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work are:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. NUCO Inc.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work are:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. NUCO Inc.
 - 2. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- E. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 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: Before installing penetration or joint firestopping systems, clean out openings or joints immediately to comply with fire-resistive system manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening, joint substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. 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. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition occurs, such as the intersection of a gypsum wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- 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.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

- D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.
- C. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner may engage a qualified testing agency to perform tests and inspections according to ASTM E2174 and ASTM E2393 as applicable.

- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill and elastomeric materials adjacent to openings and joints as the Work progresses by methods and with cleaning materials that are approved in writing by firestopping system 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 systems are 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 and joint firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Silane-modified polymer joint sealants.
 - 4. Mildew-resistant joint sealants.
 - 5. Butyl joint sealants.
 - 6. Latex joint sealants.
 - 7. Acoustical Joint Sealants.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Urethane joint sealants.
 - 4. Silane-modified polymer joint sealants.
 - 5. Mildew-resistant joint sealants.
 - 6. Butyl joint sealants.
 - 7. Latex joint sealants.
- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency
- B. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.

- C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.6 PRECONSTRUCTION TESTING

- A. 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 kind of sealant and joint substrate.
 - 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.
 - 5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - 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.
 - 6. 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.
 - 7. 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.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 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.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. The Dow Chemical Company.
 - c. Sika Corporation.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. The Dow Chemical Company.
 - c. Sika Corporation.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. The Dow Chemical Company.
 - c. Sika Corporation.

2.5 SILANE-MODIFIED POLYMER JOINT SEALANTS

- A. Silane-Modified Polymer, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, joint sealant; ASTM C920, Type S, Grade NS, Class 100, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. The Dow Chemical Company.
 - c. Sika Corporation.

2.6 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silane-Modified Polymer, Mildew Resistant, S, NS, 50, NT: Mildew-resistant, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Pecora Corporation.
- b. The Dow Chemical Company.
- c. Sika Corporation.

2.7 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation - Building Components.

2.8 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PPG Paints; PPG Industries, Inc.
 - b. Pecora Corporation.
 - c. Sherwin-Williams Company (The).
 - d. Tremco Incorporated.

2.9 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.10 ACOUSTICAL JOINT SEALANTS

- A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

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. DAP Products Inc.
 - b. Hilti, Inc.
 - c. Pecora Corporation.
2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.11 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 performance of the Work.
- 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. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

- a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. INSTALLATION OF ACOUSTICAL JOINT SEALANTS
1. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
 2. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - a. Extent of Testing: Test completed and cured sealant joints as follows:
 - 1) Perform 5 tests for the first 500 ft. (300 m) of joint length for each kind of sealant and joint substrate.
 - 2) Perform one test for each 500 ft. (300 m) of joint length thereafter or one test per each floor per elevation.
 - b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - 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.
 - c. Inspect tested joints and report on the following:
 - 1) Whether sealants filled joint cavities and are free of voids.
 - 2) Whether sealant dimensions and configurations comply with specified requirements.
 - 3) 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 complies with sealant manufacturer's field-adhesion hand-pull test criteria.

- d. 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 material, sealant configuration, and sealant dimensions.
 - e. 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.
2. 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, remove, and repair 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 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 glass unit masonry assemblies.
 - e. Joints between different materials listed above.
 - f. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - g. Control and expansion joints in ceilings and other overhead surfaces.
 - h. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:

- a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Intersection of tile flooring and thresholds.
 - d. Intersection of tile flooring and ceramic tile wall surfaces or base tiles.
 - e. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, S, NS, 100/50, T, NT.
 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. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry walls and partitions.
 - d. Joints in HDPE or other solid plastic panels.
 - e. Interior corner joints of ceramic tile wall surfaces.
 - f. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, Nonstaining, S, NS, 100/50, T, NT.
 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 Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints located in shower / changing cubicles and where indicated.
 - c. Perimeter joints at trim and flanges joining shower stall enclosures and adjoining wall surfaces.
 - d. Perimeter joints at lavatory countertops.
 - e. Joints in HDPE or other solid plastic panels subject to wet conditions.
 - f. Other joints as indicated on Drawings.
 2. Joint Sealant: Silane-modified Polymer, mildew resistant, S, NS, 50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Intersection of tile flooring and thresholds.
 - d. Intersection of tile flooring and ceramic tile wall surfaces or base tiles.
 - e. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, S, NS, 100/50, T, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint Sealant Application: Exterior joints in vertical surfaces
1. Joint Locations:
 - a. Curtainwall and storefront joints
 - b. Metal panel joints
 - c. Secondary glazing seals
 - d. Areas where seal is required against neoprene or EPDM gaskets.
 2. Joint Sealant: Butyl-Rubber Sealant
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint Sealant Application: Interior joints in acoustically-rated assemblies:
1. Joint Locations: Interior, acoustically insulated partitions.
 2. Joint Sealant: Acoustical latex specified to maintain stated STC values for acoustic assemblies as noted in the Drawings.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079513 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior expansion joint cover assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. 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. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 by a qualified testing agency.
- B. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Expansion Joint Design Criteria:
 - 1. Type of Movement: Thermal
 - 2. Joint Width:
 - a. Interior and Walls: 1 inches. Verify in field.
 - b. Exterior Walls: 0.5 inches.
 - c. Roof: 2 inches.

2.3 MANUFACTURERS

- 1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products by Balco; a CSW Industrials Company; model applicable to each condition scheduled below.

2. Alternate Manufacturers: Subject to compliance with requirements, alternate products from the following manufacturers may be provided:

- a. Construction Specialties, Inc.
- b. Erie Metal Specialties, Inc.
- c. Nystrom, Inc.

2.4 INTERIOR FLOOR EXPANSION JOINTS

- A. Flush-mounted, floor joint cover: Flush-to-floor assembly consisting of recessed base profile and cover plate anchored to floor and adjacent wall surfaces.
 1. Application: Floor to floor - "NBSF.5-1"
 2. Application: Floor to Wall – "NBSFL.5-1"
 3. Installation: Flush mounted.
 - a. Form recessed channels as required in adjacent concrete slab to accommodate profile.
 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 5. Exposed Metal:
 - a. Base: Mill Aluminum.
 - b. Cover: Stainless Steel.
 6. Movement: 50 percent.

2.5 INTERIOR WALL & CEILING INTERIOR EXPANSION JOINTS

- A. Surface-mounted, snap-on joint cover: Assembly consisting of snap on cover installed over top of surface-mounted base profiles attached to wall surface.
 1. Application: Wall to Wall - "SSWD-1"
 2. Application: Wall to Corner – "SSWDC-1"
 3. Application: Wall to Hard Ceiling – "SSWDC-1"
 4. Installation: Surface-mounted.
 5. Fire-Resistance Rating: Not less than that of adjacent construction.
 6. Exposed Metal:
 - a. Base: Mill Aluminum.
 - b. Cover: Stainless Steel.
 7. Movement: 50 percent.

2.6 EXTERIOR ROOF EXPANSION JOINTS

- A. Elastomeric-Seal roof-to-wall bellows-type joint cover: Assembly consisting of EPDM elastomeric cover anchored to adjacent surfaces with aluminum flanges and filled with closed-cell foam backers.
 1. Application: Membrane Roof-to-masonry wall - "BRBA-1-2CSE"
 2. Installation: Surface- and curb-mounted.
 3. Fire-Resistance Rating: Not less than that of adjacent construction.
 4. Exposed Metal:

- a. Base: Mill Aluminum.

- 5. Movement: 50 percent.

2.7 EXTERIOR WALL EXPANSION JOINTS

- A. Preformed elastomeric-backup expansion joint backup.

- 1. Application: New-to-existing exterior masonry wall joint - "BBSW-050"
- 2. Installation: Recessed.
- 3. Fire-Resistance Rating: Not less than that of adjacent construction.
- 4. Material: Open-cell hydrophobic polymer impregnated with polyurethane.
- 5. Movement: 50 percent.

2.8 MATERIALS

- A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), Alloy 6061-T6 for sheet and plate.
- B. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 for plates, sheet, and strips.
- C. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
- D. Fire Barriers: Any material or material combination, to comply with performance criteria for required fire-resistance rating.
- E. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.
- F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M.

2.9 FINISHES

- A. Aluminum: Mill.
- B. Stainless Steel:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 3. Run grain of directional finishes with long dimension of each piece.
 - 4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 5. Directional Satin Finish: No. 4.

2.10 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. Provide where indicated on Drawings.
- B. 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 (75 mm) from each end and not more than 24 inches (600 mm) 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.
- I. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers. Install factory-fabricated units at transition between exterior walls and soffits and roof expansion joint cover assemblies.

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 079513

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.
 - 3. Borrowed lites.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
 - 2. Section 081416 "Flush Wood Doors" for wood doors installed in steel frames.
 - 3. Section 088000 "Glazing" for glazing to be installed in metal doors and borrowed lite frames.
 - 4. Section 088853 "Security Glazing" to be installed in metal doors and borrowed lite frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

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.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 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 electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly and fire-rated borrowed-lite assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.8 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames 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 doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) 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. Curries, AADG, Inc.; ASSA ABLOY Group.
 2. Pioneer Industries; AADG, Inc.; ASSA ABLOY.

3. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m) when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.
 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
 - f. Core: Manufacturer's standard.
 - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction:
 - 1) Knocked down – where installed in steel stud framed partitions.
 - 2) Full profile welded – where installed in masonry wall construction.
 3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness:
 - 1) 2 inches (44.5 mm), minimum at new frames.
 - 2) Match existing door thickness at existing frames.
- c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
- d. Edge Construction: Model 2, Seamless.
- e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
- f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
- g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
- h. Core: Polystyrene or Polyurethane.
 - 1) Provide door assembly meeting U-Factor requirements for thermally rated assemblies.
- i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.
- j. Exterior Door Insulation: Manufacturer's standard insulation core.
 - 1) U-Value: U-0.21 minimum.

2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
- b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- B. Construction: Face welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

2.6 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 - 3. Post-installed Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite 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 welding, or by rigid mechanical anchors.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. 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.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/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 BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
 - 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. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.10 LOUVERS

- A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
- B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 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. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Floor Anchors: Secure with post-installed expansion anchors.

- a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

- A. 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.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.
2. Ballistics-resistant flush wood door and frame assemblies.
3. Light frames and louvers.

B. Related Requirements:

1. Section 087111 "Door Hardware" for door hardware for wood doors.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.
3. Section 088813 "Fire-Rated Glazing" for glass view panels in fire-rated assemblies.
4. Section 088853 "Security Glazing" for glass view panels in flush wood doors where indicated.

1.2 REFERENCES

- A.** Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment.
B. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass.

1.3 PREINSTALLATION MEETINGS

- A.** Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A.** Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B.** Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
 3. Details of frame for each frame type, including dimensions and profile.
 4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 5. Dimensions and locations of blocking for hardware attachment.
 6. Dimensions and locations of mortises and holes for hardware.
 7. Clearances and undercuts.
 8. Doors to be factory finished and application requirements.

- 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 (200 by 250 mm), for each material and finish.
 - 2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Special warranties.
- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.9 WARRANTY

- A. Special Warranty: 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. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.

- c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
2. Warranty also includes 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 SOURCE LIMITATIONS

- A. Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Masonite Architectural.
 - b. Oshkosh Door Company.
 - c. VT Industries, Inc.
 2. Performance Grade by Location:
 - a. Closets and Office Suite Storage Rooms (excluding Custodial Closets):
 - 1) ANSI/WDMA I.S. 1A Standard Duty.
 - b. All other locations:
 - 1) ANSI/WDMA I.S. 1A Extra Heavy Duty.
 3. Acoustic Rating by Location (STC construction):
 - a. Doors within acoustically-insulated partitions: STC-35
 - b. All other locations: STC-30

4. ANSI/WDMA I.S. 1A Quality Grade: Premium.
5. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.
 - a. Species: Red oak or White oak.
 - b. Cut: Rift cut.
 - c. Match between Veneer Leaves: Book match.
 - d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - f. Room Match:
 - 1) Provide door faces of compatible color and grain within each separate room or area of building.
6. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors:
 - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 550 lbf (2440 N) in accordance with WDMA T.M. 10.
7. Core:
 - a. WDMA I.S. 10 structural composite lumber.
8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 BULLET-RESISTANT DOOR AND FRAME ASSEMBLIES

A. Basis of Design:

1. Subject to compliance with requirements, provide products by the following:
 - a. Total Security Solutions, Inc., 935 Garden Lane, Fowlerville, MI 48836, 866 734-6277. Attn: Sales Department, sales@tssbulletproof.com. Web: www.tssbulletproof.com.
2. Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable if approved in accordance with Section 012500 "Substitution Procedures."

B. Design Performance:

1. Through the design, manufacturing techniques and material application the TSS Bullet Resistant Wood Door and Frame Assembly shall be constructed of a wood core lined with a sheet of fiberglass.
2. Door assembly to have no exposed fasteners.
3. Joint connections to have concealed clips to provide rigid assembly when installed.
4. Frames shall be non-rated.
5. All joints and connections shall be tight, providing hairline points and true alignment of adjacent members.

C. Door and Frame Assembly Dimensions: As indicated on the Drawings.

D. Door and Frame Performance:

1. Standard door and frame assembly to defeat ballistic assaults as tested with UL Standard 752 at Underwriters Laboratories, Level 3.
2. Door Size: 36" x 84" (finish opening 40" x 86"), Jamb Tube 1 3/4" x 4"
3. Door Frame Construction: Frames shall a Knocked Down or Welded Hollow Metal Frame primed in fabrication.

E. Bullet-Resistant Glazing:

1. Level 3 in accordance with UL 752 – Testing for Ballistic Resistance for the complete assembly including framing and panels.

F. Field alterations to the construction of the assembly fabricated under the acceptable standards are not allowed unless approved in writing by the manufacturer and the Architect.

G. Standard manufacturing tolerances +/- 1/16" shall be maintained.

2.6 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer's standard shape.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. 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 on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

- D. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: Flat.
- E. Metal Louvers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASSA ABLOY.
 - b. Allegion plc.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - 2. Blade Type: Vision-proof, inverted V.
 - 3. Metal and Finish:
 - a. Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, with baked-enamel- or powder-coated finish.
- F. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASSA ABLOY.
 - b. Allegion plc.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - 2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, with baked-enamel- or powder-coated finish.

2.7 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
 - 1. Locate hardware to comply with DHI-WDHS-3.
 - 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 - 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 - 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 - 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.

2.8 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 2. Finish faces, all four edges, edges of cutouts, and mortises.
 - 3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 - 1. ANSI/WDMA I.S. 1A Grade: Premium.
 - a. TR-8 UV Cured Acrylated Polyester/Urethane.
 - 2. Staining: As selected by Architect from manufacturer's full range.
 - 3. Sheen: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed 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 087111 "Door Hardware (Descriptive Specification)."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 - 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
 - 2. Anchor frames to anchors or blocking built in or directly attached to substrates.

- a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
- 3. Install fire-rated doors and frames in accordance with NFPA 80.
- 4. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 - 2. Machine doors for hardware.
 - 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 4. Clearances:
 - a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
 - d. Comply with NFPA 80 for fire-rated doors.
 - e. Undercut doors 3/4 inch at the following locations:
 - 1) Toilet Rooms and Locker Rooms without dedicated return air ducts or door louvers.
 - 5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 - 6. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Provide inspection of installed Work through WI's Certified Compliance Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
 - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically

controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames.
 - 2. Fire-rated access doors and frames.
- B. Related Requirements:
 - 1. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.4 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies meets the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Nystrom, Inc.
2. Description: Face of door flush with frame; with concealed flange for gypsum board or plaster installation and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: Per drawings or as required for functional access.
5. Metallic-Coated Steel Sheet for Door: Nominal **0.064 inch (1.63 mm)**, 16 gage factory primed.
6. Frame Material: Same material and thickness as door.
7. Latch and Lock: Cam latch, key operated.

B. Recessed Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Nystrom, Inc.
2. Description: Door face recessed as necessary for ceramic tile infill flush with adjacent finished tile surface; with concealed flange for ceramic tile installation and concealed hinge.
3. Locations: Wall.
4. Door Size: Per drawings or as required for functional access.
5. Stainless Steel Sheet for Door: Nominal **0.062 inch (1.59 mm)**, 16 gage, ASTM A480/A480M No. 4 finish.
6. Latch and Lock: Cam latch, key operated.

C. Lightweight Flush Access Doors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Nystrom, Inc.
2. Description: Face of door flush with exposed flange, with exposed piano hinge; frameless for surface installation.
3. Locations: Wall and ceiling.
4. Door Size: Per drawings or as required for functional access.
5. Metallic-Coated Steel Sheet for Door: Nominal **0.022 inch (0.56 mm)**, 26 gage, factory primed.
6. Frame Material: Aluminum, nominal **0.045 inch (1.15 mm)**, mill finish.

7. Latch and Lock: Cam latch, key operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Nystrom, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: Per drawings or as required for functional access.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of 30 minutes.
7. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gage, factory primed.
8. Frame Material: Same material, thickness, and finish as door.
9. Latch and Lock: Self-latching door hardware, operated by key.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- E. Stainless Steel Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- F. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.
- G. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- H. Frame Anchors: Same material as door face.
- I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 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 mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
 - 1. For recessed doors with plaster or ceramic tile infill, provide self-furring expanded-metal lath attached to door panel.
- E. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock.
- F. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical 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. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- E. Stainless Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: ASTM A480/A480M No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 083300 - OVERHEAD COILING DOORS AND SIDE-FOLDING GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors.
 - 2. Aluminum, manually-operated, side-folding grilles
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 2. Show locations of controls, locking devices detectors or replaceable fusible links, and other accessories.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance data.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. Overhead Door and Operator: Three years from date of Substantial Completion.
 - b. Side-Folding Grille: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS – OVERHEAD DOORS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.

2.2 DESIGN / PERFORMANCE REQUIREMENTS – SIDE-FOLDING GRILLES

- A. Stacking:
 - 1. Minimum stacking shall be 1.05 inches/linear foot (87.5 mm/meter) of opening plus 3.5 inches (89 mm) for each locking member.
 - 2. Grille support must be designed to carry the weight of a fully stacked door at any point along its length. Support is to carry the total weight / the total stacking and is expressed as lbs. per linear ft.
- B. Lintel Deflection: Accommodate deflection of lintel to prevent damage to components, deterioration of seals, or movement between door frame and perimeter framing.

2.3 OVERHEAD DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Stormite Model 625 Insulated Heavy-Duty Rolling Service Door or a comparable product by one of the following:

- a. Clopay Building Products.
 - b. Cornell; a CornellCookson company.
 - c. McKeon Door Company.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000 cycles.
- C. Insulated Door Curtain R-Value: 7.0 minimum
- D. Insulated Door Assembly U-Factor: 0.15 minimum
- E. Door Curtain Material: 24 ga., galvanized steel, powder coated finish as selected by Architect from Manufacturer's full range.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
 1. Insulated-Slat Interior Facing: Metal.
- G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dipped, galvanized steel or aluminum extrusions and finished to match door.
- H. Curtain Jamb Guides: Powder-coated galvanized steel or Aluminum with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish.
 1. Mounting: Face of wall.
- J. Locking Devices: See Door Hardware Schedule
 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with and outside with cylinder.
- K. Manual Door Operator: Manufacturer's standard crank or Chain-hoist operator.
- L. Electric Door Operator:
 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
 2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
 3. Motor Exposure: Interior.
 4. Motor Electrical Characteristics:
 - a. Horsepower: 1/3 hp, minimum.
 - b. Voltage: 115 V ac, single phase, 60 Hz.
 5. Emergency Manual Operation: Chain or Crank type, Accessible.
 6. Obstruction-Detection Device: Automatic photoelectric sensor or electric sensor edge on bottom bar.
 7. Control Station(s): Where indicated on Drawings.
- M. Secure Disable: Door to be manually disabled and locked via key cylinder.
- N. Curtain Accessories: Equip door with weatherseals.

O. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Finish as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm) and minimum aluminum thickness of 0.032 inch (0.80 mm).
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
 2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.7 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock compatible with Owner's master keying system, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087111 "Door Hardware (Descriptive Specification)" and keyed to building keying system.
- B. Chain Lock Keeper: Suitable for padlock.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- D. **For the purpose of evidence security, doors shall be made fully inoperable via key cylinder.**

2.8 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

2.9 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 1. Comply with NFPA 70.
 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Motors: Reversible-type motor for motor exposure indicated for each door assembly.
 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

- D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - 2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
- E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - 2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- I. Remote Operation: Provide TWELVE (12) programmable, two-button, rolling-code, transmitters suitable for installation in Owner's vehicles.

2.11 SIDE-FOLDING GRILLE

- A. Aluminum, manually operated, side-folding grilles that stack
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Cornell Ironworks (a Cornelle Cookson company); "ESG32 – GlideGard" Side-Folding Open Aluminum Grille or a comparable product by one of the following:
 - a. Overhead Door Corporation
 - b. Clopay Building Products.
- B. Curtain:
 - 1. Vertical Tubes: 5/16 inch (8 mm) diameter, 6063 T5 aluminum alloy, 3.5 inches (89 mm) on center.
 - 2. Tube Spacers: 7/16 inch (11 mm) outside diameter aluminum tubes to maintain horizontal chain spacing.

3. Horizontal Bars: Aluminum bars, 6 inches x 3/4 inch (152 mm x 19 mm), Bars to be vertically spaced at 9 inches (229 mm) o.c. in a brick pattern.
 4. Hinge Panels: 2 inch (51 mm) high continuous interlocking aluminum panels at the top and bottom of the closure.
 5. Leading End Member: 1 5/16 x 2 3/8 x 1/8 inch (33 x 60 x 3 mm) thick extruded aluminum tube with recess for attaching curtain sections.
 - a. Provide concealed masterkeyable, cylinder operated hook-bolt #7 member with lock operable from both sides of curtain that engages a full height wall channel. Provide rubber bumper at the edge of the locking member.
 6. Intermediate Member(s): 1 5/16 x 2 3/8 x 1/8 inch (33 x 60 x 3 mm) thick extruded aluminum tube with recess for attaching curtain sections.
 7. Trailing End Member: 1 5/16 x 2 3/8 x 1/8 inch (33 x 60 x 3 mm) thick extruded aluminum tube with recess for attaching curtain sections.
 - a. Provide #8 fixed end member.
- C. Trolleys: 1 1/8 inch (29 mm) diameter nylon tired ball bearing wheels; two wheel assembly at each hanger; three wheel assembly at all vertical members.
- D. Track: 1.3 x 1.8 inch (33 x 46 mm) thick extruded aluminum section with continuous recess for splice tongues and pins.
 1. Provide 90 with a 10 inch (254 mm) radius.
- E. Finishes: To be selected from manufacturer's standard options.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install overhead coiling doors, operating equipment and side-folding grilles complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.3 DEMONSTRATION – Overhead Doors

- A. Overhead Doors: Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.
- B. Side-folding Grilles: Demonstrate proper operation to Owner's Representative and instruct in maintenance procedures.

END OF SECTION 083323

SECTION 085413 FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fiberglass-framed windows.
- B. Related Requirements:
 - 1. Section 085413 "Fiberglass Windows" for fiberglass-framed exterior windows.
 - 2. Section 088000 "Glazing" for general specification information for all glazing including information applicable to Security Glazing.
 - 3. Section 088853 "Security Glazing" for ballistic-glazed transaction windows.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for fiberglass windows.
- B. Shop Drawings: For fiberglass windows.
 - 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For fiberglass windows and components required, prepared on Samples of size indicated below:
 - 1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
 - 2. Exposed Hardware: Full-size units.
- D. Product Schedule: For fiberglass windows. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of fiberglass window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating fiberglass windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: An installer acceptable to fiberglass window manufacturer for installation of units required for this Project.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace fiberglass windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units, Non-Laminated: 20 years from date of Substantial Completion.
 - c. Glazing Units, Laminated: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain fiberglass windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: CW.
 - 2. Minimum Performance Grade: 45.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of
 - 1. Fixed Units: 0.38 Btu/sq. ft. x h x deg F.
 - 2. Operable Units: 0.45 Btu/sq. ft. x h x deg F.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of:

1. South, East and West Exposure: 0.36/
2. North Exposure: 0.48.

- E. Sound Transmission Class (STC): Rated for not less than 32 STC when tested for laboratory sound transmission loss in accordance with ASTM E90 and determined by ASTM E413.
- F. Outside-Inside Transmission Class (OITC): Rated for not less than 27 OITC when tested for laboratory sound transmission loss in accordance with ASTM E90 and determined by ASTM E1332.

2.3 FIBERGLASS WINDOWS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Pella Corporation; Pella Impervia or comparable product by one of the following:
1. Inline Fiberglass Ltd.
 2. Kolbe Windows & Doors.
- B. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Casement: Project out.
 2. Fixed.
- C. Frames and Sashes: Pultruded fiberglass complying with AAMA/WDMA/CSA 101/I.S.2/A440 and with exposed exterior fiberglass surfaces finished with manufacturer's standard enamel coating complying with AAMA 623.
1. Exterior Color: White.
 2. Interior Finish: White.
- D. Glazing: See Sections 0880000 "Glazing" and 088853 "Security Glazing."
- E. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock fiberglass windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- F. Projected Window Hardware:
1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested in accordance with ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
 - a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.
 2. Hinges: Stainless steel hinges with stainless steel-reinforced, sliding nylon shoes.
 3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one arm on sashes up to 27-1/2 inches (700 mm) tall and two arms on taller sashes.

4. Locking Device: Custodial key lock. Provide three (3) keys to Owner.

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: One permanently located between insulating-glass lites.
2. Material: Aluminum.
3. Pattern: As indicated on Drawings.
4. Profile: 0.75 inch (19 mm) contoured.
5. Color: White.

B. Trim: Provide all necessary trim components for a full installation within the wall constructions specified including exterior polyurethane brick molds, interior wood extension jambs and wood stools.

2.5 FABRICATION

A. Fabricate fiberglass windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze fiberglass windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately in accordance with manufacturer's written instructions.

END OF SECTION 085413

SECTION 085653 - SECURITY WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Bullet resistant vertical baffle window system.
- B. Related Sections
 - 1. Section 088853 "security Glazing" for ballistic-resistant window glazing.
 - 2. Section 123661.19 "Quartz Agglomerate Countertops" for horizontal transaction surfaces.

1.2 REFERENCES

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment.
- B. ASTM E119-98- Standard Test Methods for Fire Tests of Building Construction and Materials,
- C. ASTM B 209/B 209M- Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate,
- D. ASTM A 666-Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Samples: For frame members with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranty: Sample warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations provided by manufacturer. Do not install products stored in conditions outside manufacturer's recommended limits.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.
 - 1. Workmanship Warranty Period: One (1) year from date of Substantial Completion.
 - 2. Finish Warranty Period: Manufacturer's warranty against deterioration of factory finishes for the period of 10 years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
 - 1. Ballistics Resistance, UL 752: **Level 3** in accordance with UL 752.
 - 2. Through the design, manufacturing techniques and material application, window shall be of the non-ricochet type.
 - 3. The assembly shall provide for single or multiple transaction positions utilizing the natural voice baffle configuration.
 - 4. This assembly shall employ offset vertical standing vision panels and 5/8" vertical baffles to complete the natural voice design and protect against angled ballistic penetrations.
 - 5. Each transaction position may have a stainless-steel dip tray as shown on the drawings.
 - 6. Panels shall not be removable from threat side.
 - 7. Provide anchor screws as required to install equipment.
- B. Field alterations to the construction of the assembly fabricated under the acceptable standards are not allowed unless approved in writing by the manufacturer and the Architect.
- C. Standard manufacturing tolerances +/- 1/16" shall be maintained.
- D. Materials shall meet or exceed UL 752 requirements.

2.2 FIXED, TRANSACTION SECURITY WINDOWS

- A. Provide fixed, baffle-style transaction security windows with operable sash or ventilator capable of allowing transfer of currency and documents.

1. Basis of Design: Subject to compliance with requirements, provide products by the following or approved equal:
 - a. Total Security Solutions, Inc.; 935 Garden Lane, Fowlerville, MI 48836, 866-734-6277; www.tssbulletproof.com
2. Configuration: As indicated on Drawings.

2.3 FABRICATION

- A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
- B. Aluminum sections to be manufactured in accordance with ASTM B209, Extruded aluminum alloy 6063 T5 Anodized to match the existing décor and be free of sharp edges or burrs when in place.
- C. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment. All exposed aluminum edges shall be clean cut and have no burrs. Exposed corners shall be rounded and sanded.
- D. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members
- E. Factory-cut openings in glazing for speaking apertures.

2.4 METALLIC-COATED STEEL SHEET FINISHES

- A. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the coating to be applied over it.
- B. Color: To be selected by Architect from manufacturers available non-custom options.
 1. Clear Anodic Finish: Architectural Class I, clear coating AA-M10C22A41 Mechanical Finish Chemical Finish: etched, medium matte; 0.70 mils minimum complying with AAMA 611 "Voluntary Specification for Anodized Architectural Aluminum"
 2. Color Anodic Finish: Architectural Class I, clear or color coating AA-M10C22A42/A44 Mechanical Finish Chemical Finish: etched, medium matte; 0.70 mils minimum complying with AAMA 611 "Voluntary Specification for Anodized Architectural Aluminum".
- C. Cap the bottom of glazing with the corresponding finish material selected for frame

2.5 ACCESSORIES

- A. Recessed, Nonricochet Deal Trays: Formed from stainless steel; fabricated with recessed bullet trap to ricochet bullets away from secure side, with exposed flanges for recessed installation into horizontal surface.
 1. Basis of Design: Subject to compliance with requirements, provide products by the following or approved equal:

- a. Total Security Solutions, Inc.; 935 Garden Lane, Fowlerville, MI 48836, 866-734-6277; www.tssbulletproof.com
 2. Tray size: Standard size of tray to be 16 inches by 10 inches from the outside edge of flanges with a clear open depth under the glazing no less than 1-1/2 inch.
 3. Material: Tray shall be fabricated from minimum 18-gauge stainless steel and with No. 4 finish.
 4. Bullet-resistance to match adjacent wall and window construction.
 5. Components shall be manufactured in strict accordance with the specifications, design and details, to be in conformance with required UL ballistics level indicated.
 6. Listed and labeled as bullet resisting in accordance with UL 752.
- B. Speaking Apertures: Fabricate from **stainless steel** designed to allow passage of speech at normal speaking volume without distortion.
1. Shape: **Circular**.
 2. Ballistics Resistance: **Same as security window**.
 3. Listed and labeled as bullet resisting in accordance with UL 752.
- C. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.
- D. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum **3/16 inch (4.8 mm)** thick; with minimum **1/2-inch- (12.7-mm-)** diameter, headed studs welded to back of plate.
- E. Glazed Framing: Provide **gasket**-glazed framing.
1. Interior: Closed cell neoprene.
- F. Removable Glazing Stops and Trim: Fasten components with security fasteners.
- G. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.
- H. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to beginning installation, verify that all supports have been installed as required by the Contract Documents and architectural drawings, and Shop Drawings have been approved.
- B. Notify Architect of any unsatisfactory preparation that is responsibility of others.
- C. Clean and prepare all surfaces per manufacturers recommendations as required for achieving the best results for the substrate under the project conditions.
- D. Verify field dimensions of openings prior to fabrication of framing.
- E. Coordinate structural requirements to ensure proper attachment and support.

- F. Do not begin installation of material until all unsatisfactory conditions have been resolved and approved by Architect.

3.2 INSTALLATION

- A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings.
- B. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb.
- C. All products shall be installed per installation instructions provided by manufacturer.
- D. Security window units shall arrive on site completely pre-fabricated to field dimensions approved by Shop Drawings.
- E. Install framing and secure to structure in accordance with manufacturer's recommendations and approved shop drawings.
- F. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.
- G. Apply sealant in accordance with window and sealant manufacturer's recommendations as indicated in installation instructions.
- H. Remove excess sealant and leave exposed surfaces clean and smooth

3.3 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.4 CLEANING AND PROTECTION

- A. Clean and protect windows from damage during ongoing construction operations. If damage occurs, remove and replace as required to provide windows in their original, undamaged condition.
- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements.
- C. Provide final cleaning of product and accessories, removing excess sealant, labels and protective covers.
- D. Touch-up, repair or replace damaged products prior to Substantial Completion.

END OF SECTION 085653

SECTION 087111 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Center-hung and offset pivots.
3. Continuous, gear-type hinges.
4. Bored locks.
5. Mortise locks.
6. Interconnected locks.
7. Bored auxiliary locks.
8. Mortise auxiliary locks.
9. Electric strikes.
10. Electromechanical locks.
11. Manual flush bolts
12. Exit devices and auxiliary items.
13. Lock cylinders.
14. Key control cabinet.
15. Operating trim.
16. Surface closers.
17. Concealed closers.
18. Closer holder release devices.
19. Wall- and floor-mounted stops.
20. Electromagnetic door holders.
21. Overhead stops and holders.
22. Door gasketing.
23. Thresholds.
24. Sliding door hardware.
25. Metal protective trim units.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames".
2. Section 081416 "Flush Wood Doors" for provided as part of labeled fire-rated assemblies.
3. Section 083113 "Access Doors and Frames" for access door hardware, including cylinders.
4. Section 083300 – "Overhead Coiling Doors and Side Folding Grilles" for door hardware provided as part of overhead coiling door assemblies and side folding grille assemblies.
5. Section 102113.19 "Plastic Toilet Compartments" for hardware associated with or provided by Partition installer.
6. Section 284621.11 "Addressable Fire-Alarm Systems" for connections to building fire-alarm system.

1.2 COORDINATION

- A. Floor-Recessed Door Hardware:** Coordinate layout and installation with floor construction.

1. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at location to be determined.
 1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.
- B. Keying Conference: Conduct conference at location to be determined.
 1. Conference participants must include Installer's Architectural Hardware Consultant.
 2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system, including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

1.4 ACTION SUBMITTALS

- A. Product Data:
 1. For each product type provided.
 2. Auxiliary door hardware.
 3. Auxiliary electrified door hardware.
 4. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Data Submittals: For each product.
- C. 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.

- D. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
 - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- E. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of product data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 - 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- F. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
 - 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

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. Furnish complete set of special tools required for maintenance and adjustment of hardware including changing of cylinders.
 - 2. Turn over unused materials to Owner for maintenance purposes.
 - 3. Door Hardware:
 - a. Hinges: 3 pairs.
 - b. Bored locks: 2 of each function.
 - c. Mortise locks: 3 of each lock function.
 - d. Interconnected locks: 1
 - e. Electric strikes: 2 (if applicable)
 - f. Electromechanical locks: 2 locksets.
 - g. Exit devices and auxiliary items: 1 for each type provided.
 - h. Lock cylinders: 6
 - i. Operating trim: 2 of each type provided.
 - j. Surface closers: 2
 - k. Wall- and floor-mounted stops: 3 for each provided.
 - l. Overhead stops and holders: 2
 - m. Door gasketing: 2 full replacements.
 - n. Metal protective trim units: 2 each size provided.
 - o. Lockset Escutcheons: 4 of each type.
 - p. Levers: 3 pair
 - q. Silencers: 50.
 - 4. Electrical Parts:
 - a. Power Transfers: 2 for each type provided

1.8 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. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.

3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- B. 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 a Door and Hardware Specification Consultant (DHSC) or an Architectural Opening Consultant (AOC).

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.10 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. Failures include, but are not limited to, the following:
 - a. Structural failures, including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
 - b. Exit Devices:
 - 1) Mechanical: Three years from date of Substantial Completion.
 - 2) Electrical: Two years from date of Substantial Completion.
 - c. Manual Closers: 25 years from date of Substantial Completion.
 - d. Concealed Closers: 25 years from date of Substantial Completion.
 - e. Continuous Hinges: Lifetime.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 1. Air-Leakage Rate: Maximum air leakage of 0.3 cfm per sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3 inch wg (75 Pa) of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 - 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 MANUFACTURERS

- A. Manufacturers: Unless noted otherwise below, and subject to compliance with requirements, provide products by one of the following or its subsidiary brands:
1. Allegion plc.
 2. ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 3. STANLEY; dormakaba USA, Inc.

2.4 HINGES

- A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
- B. Antifriction-Bearing Hinges and Electrified Antifriction-Bearing Hinges:
1. Mounting: Full mortise (butts).
 2. Bearing Material: Ball bearing.
 3. Grade 1 (heavy weight).
 4. Base and Pin Metal:
 - a. Exterior Hinges: Stainless steel with stainless steel pin.
 - b. Interior Hinges: Steel with steel pin.
 - c. Hinges for Fire-Rated Assemblies: Steel with steel pin.
 5. Pins: Nonremovable.
 - a. Outswinging Exterior Doors: Nonremovable.
 - b. Outswinging Corridor Doors with Locks: Nonremovable.
 6. Tips: Flat button.
 7. Corners: Square.
 8. Electric Feature: Concealed electric through wires with monitor.

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 (13-mm) latchbolt throw.
 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.
- D. Lock Trim:
1. Levers: Cast.
 2. Description: To be selected from manufacturer's available options in specified finish.
 - a. Construction: Solid.

3. Escutcheons (Roses): Cast.
 4. Dummy Trim: Match lever lock trim and escutcheons.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- F. Bored Locks: ANSI/BHMA A156.2, Grade 1, Series 4000.
- G. Mortise Locks: ANSI/BHMA A156.13, Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
- H. Interconnected Locks: ANSI/BHMA A156.12, Grade 1, Series 5000.

2.6 AUXILIARY LOCKS

- A. Bored Auxiliary Locks: ANSI/BHMA A156.36, Grade 1; with strike that suits frame.
1. Backset: 2-3/4 inches (70 mm).
 2. Material: Bronze.
 3. Deadlocks: Deadbolt operated by key either side.
- B. Mortise Auxiliary Locks: ANSI/BHMA A156.36, Grade 1; with strike that suits frame.
1. Backset: 2-3/4 inches (70 mm).
 2. Material: Bronze.
 3. Deadlatches: Latchbolt and auxiliary deadlatch operated by key either side.

2.7 ELECTRIC STRIKES

- A. Electric Strikes: ANSI/BHMA A156.31, Grade 1; with faceplate to suit lock and frame.
1. Material: Steel.
 2. Mounting: As required for locking hardware.
 3. Fire-Rated Door Assemblies: Use fail-secure electric strikes with fire-rated devices.
 4. Monitoring: Mechanical latchbolt or Mechanical strike as required.

2.8 ELECTROMAGNETIC LOCKS

- A. Electromagnetic Locks: ANSI/BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.

1. Direct-Hold Type: Lock mounted on bottom of header; strike flush mounted on door push side.
2. Strength Ranking: 1000 lbf (4448 N).
3. Residual Magnetism: Not more than 4 lbf (18 N) to separate door from magnet.
4. Features:
 - a. Magnetic bond sensor.
 - b. Adjustable time delay with automatic relock.
 - c. Integral door position switch.

2.9 ELECTROMECHANICAL LOCKS

- A. Electromechanical Locks: ANSI/BHMA A156.25, Grade 1; motor or solenoid driven; with strike that suits frame.
 1. Type: As indicated in Hardware Schedule.
 2. Options:
 - a. RX (request to exit)
 - b. To accept Small Format Interchangeable Core (SFIC).

2.10 SELF-CONTAINED ELECTRONIC LOCKS

- A. Self-Contained Electronic Locks: ANSI/BHMA A156.25; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.
 1. Type: As indicated in Hardware Schedule.
 2. Actuating Device: Smart-card reader.
 - a. Card: Manufacturer's standard.
 - b. Accessory: Card encoder and software.
 3. Lock Trim: Match trim specified for mechanical locks.
 4. Function: As noted in Hardware Schedule.
 5. Options:
 - a. RX (request to exit)
 - b. To accept Small Format Interchangeable Core (SFIC).

2.11 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: ANSI/BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
- B. Manual-Extension Flush Bolts: Grade 1, fabricated from extruded brass or aluminum, with 12-inch (305-mm) rod actuated by flat lever.
 1. Strike: Matching, Dustproof.
 2. Fire Rated: Listed and labeled for use in fire-rated assemblies.

- C. Top-Bolt Extension Rod Length: As required to locate operating mechanism at not more than 72 inches (1829 mm) above the finished floor at all times.
- D. Dustproof Strikes: Grade 1, polished wrought brass, with 3/4-inch- (19-mm-) diameter, spring-tension plunger.

2.12 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3.
- B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.
- C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing in accordance with UL 305 and NFPA 252.
- D. Exit Devices: Includes: Rim-mounted, Mortised, Surface and Concealed Vertical Rod and Combination Exit Devices.
 - 1. Grade 1.
 - 2. Type: As noted in door schedule and compatible with specified door elevation.
 - 3. Actuating Bar: Push pad.
 - 4. Material: Stainless steel or Aluminum.
 - 5. Electrified Features:
 - a. Push pad monitor switch.
 - b. Electric locking and unlocking.
 - c. Fail-secure electric latch retraction (dogging) that engages latch when fire-alarm system is activated.
- E. Exit Device Outside Trim: As noted in Hardware Schedule; material and finish to match locksets unless otherwise indicated.
 - 1. Match design for lock trim unless otherwise indicated.

2.13 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
- B. Manufacturers: Subject to compliance with requirements, provide one of the following products:
 - 1. BEST Access Cormax; STANLEY; dormakaba USA, Inc.
 - 2. Keymark; Yale; ASSA ABLOY Group, Inc.; ASSA ABLOY.
 - 3. Schlage Everest; Allegion plc.
- C. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable.
 - 2. Number of Pins: Seven.
 - 3. Lock Type: As compatible with each hardware set in Door and Hardware Schedule.

- D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.14 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
 - 1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
 - a. Provide three cylinder change keys and five each of master and grand master keys.
 - 2. Keyed Alike: Key all cylinders to same change key.
- B. Manufacturers: Subject to compliance with requirements, provide one of the following products:
 - 1. BEST Access Cormax; STANLEY; dormakaba USA, Inc.
 - 2. Keymark; Yale; ASSA ABLOY Group, Inc.; ASSA ABLOY.
 - 3. Schlage Everest; Allegion plc.
- C. 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."

2.15 KEY CONTROL SYSTEM

- A. Key Control Cabinet: ANSI/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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Key Boxes and Cabinets.
 - b. Lund Equipment Co., Inc.
 - c. MMF Industries.
 - 2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
- B. Key Lock Boxes: Provided by Owner, installed by General Trades contractor.

- C. Key Control System Software: By Owner if applicable.

2.16 OPERATING TRIM

- A. Operating Trim: ANSI/BHMA A156.6; stainless steel unless otherwise indicated.
- B. Flat Push Plates: With square corners and beveled edges; secured with exposed screws.
 - 1. Thickness: 0.050 inch (1.3 mm).
 - 2. Size: 4 inches wide by 16 inches high (102 mm wide by 406 mm high).
- C. Push-Pull Plates: With square corners, beveled edges, and raised integral lip; secured with exposed screws.
 - 1. Thickness: 1/8 inch (3.2 mm).
 - 2. Size: 3-1/2 inches wide by 15-3/4 inches high (89 mm wide by 400 mm high).
- D. Straight Door Pulls:
 - 1. Type: 3/4-inch (19-mm) constant-diameter pull.
 - 2. Mounting: Surface applied with concealed fasteners.
 - 3. Minimum Clearance: 1-1/2 inches (38 mm) from face of door.
 - 4. Overall Length: 9 inches (229 mm).
- E. Offset Door Pulls: 1-inch (25-mm) constant-diameter pull.
 - 1. Mounting: Manufacturer's standard.
 - 2. Overall Pull Length: 9 inches (229 mm).
- F. Flush Door Pulls: Mortised 1/2 inch (13 mm) deep; secured with screws.
 - 1. Shape: Rectangular with rectangular recess.
 - 2. Size: 3-1/2 inches wide by 4-3/4 inches high (89 mm wide by 121 mm high).
- G. Offset Push-Pull Door Pulls: Pull fixed to 0.050-inch- (1.3-mm-) thick plate, 4 inches wide by 16 inches high (102 mm wide by 406 mm high) with square corners and beveled edges.
 - 1. Pull Diameter: 1-inch (25-mm) constant diameter.
 - 2. Pull Offset: 2 inches (51 mm).
 - 3. Minimum Pull Clearance: 2-1/4 inches (57 mm) from face of door.
 - 4. Overall Pull Length: 9 inches (229 mm).
- H. Single Push Bar: Horizontal-bar type.
 - 1. Mounting: Surface applied with concealed fasteners.
 - 2. Shape and Size: 1-inch (25-mm) constant-diameter round bar.
 - 3. Minimum Clearance: 1-1/2 inches (38 mm) from face of door.

2.17 SURFACE CLOSERS

- A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- B. Surface Closer with Cover: Grade 1; modern type with mechanism enclosed in cover.
 - 1. Mounting: Parallel arm.
 - 2. Type: Hold-open.
 - 3. Cover Material: Aluminum.

2.18 CONCEALED CLOSERS

- A. Concealed Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- B. Concealed-in-Door Closer: Grade 1; mortised into top rail of minimum 1-3/4-inch- (44-mm-) thick doors and track mortised into head frame; with double-lever arm indicated.
 - 1. Type: Manufacturer's standard.
- C. Concealed Overhead Closer: Grade 1; mortised into head frame; with cast-metal body and exposed cover plate.
 - 1. Type: Manufacturer's standard.
- D. Concealed Floor Closer: Grade 1; with cement case and cast-iron closer body case and top pivot.
 - 1. Closer Type: Manufacturer's standard.

2.19 CLOSER HOLDER RELEASE DEVICES

- A. Closer Holder Release Devices: ANSI/BHMA A156.15, Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door must become self-closing on interruption of signal to release device. Automatic release is activated by smoke detection system or loss of power.
 - 1. Type: Single-point hold-open.
 - 2. Mounting: Surface mounted on face of door.
 - 3. Features:
 - a. Adjustable backcheck.
 - b. Adjustable spring power.
 - c. Adjustable hold-open manual release force.

2.20 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16; polished cast-brass, -bronze, or -aluminum base metal.
- B. Rigid-Type Floor Stop: Grade 1; with rubber bumper; cylindrical modern style.
 - 1. Installation: Manufacturer's standard.
 - 2. Provide with extruded-aluminum riser for carpet installations.
- C. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall; with backplate for concealed fastener installation.
 - 1. Bumper Configuration: Concave.

2.21 ELECTROMAGNETIC STOPS AND HOLDERS

- A. Electromagnetic Door Holders: ANSI/BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interfaced with fire-alarm system for labeled fire-rated door assemblies.

2.22 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: ANSI/BHMA A156.8.
 - 1. Grade 1.

2.23 DOOR GASKETING

- A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
- B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg (75 Pa), as follows:
 - 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 - 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 - 3. Gasketing on Double Doors: 0.50 cfm per ft. (0.000774 cu. m/s per m) of door opening.
- C. Adhesive-Backed Perimeter Gasketing: Neoprene bulb gasket material applied to frame rabbet with self-adhesive.
- D. Door Sweeps: Nylon brush gasket material held in place by flat housing or flange; surface mounted to face of door with screws.
 - 1. Housing or Flange Material: Aluminum.
- E. Automatic Door Bottoms: Nylon brush gasket material held in place by housing that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.

1. Housing Material: Aluminum.
2. Mounting: Manufacturer's standard.
3. Type: Low-closing-force type for doors required to meet accessibility requirements.

2.24 THRESHOLDS

- A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.
- B. Saddle Thresholds:
 1. Type: Fluted top, barrier free.
 2. Base Metal: Stainless steel.
- C. Half-Saddle Thresholds: Fluted-top metal member; and base metal of stainless steel.
- D. Latching/Rabbeted Panic Thresholds:
 1. Type: Fluted, barrier free top.
 2. Base Metal: Stainless steel.
- E. Plate Thresholds: Solid metal plate.
 1. Top Surface: Fluted with slip-resistant abrasive.
 2. Base Metal: Stainless steel.
- F. Ramped Thresholds: Modular, interlocking, sloped, fluted-top metal assemblies with closed return ends; 1:12 slope.
 1. Top Surface: Fluted with slip-resistant abrasive.
 2. Base Metal: Stainless steel.

2.25 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
- B. Kick Plates: 8 inches (203 mm) high by door width less 2 inches unless noted otherwise in hardware schedule

2.26 AUXILIARY DOOR HARDWARE

- A. Auxiliary Door Hardware: ANSI/BHMA A156.16.
- B. Coat Hooks: Grade 1; two curved hooks with rounded ends; 3-inch (75-mm) projection from wall; for surface-screw application.
 1. Material: Cast brass; finish to match typical.
- C. Fire-Rated Door Viewers: Solid brass with optical glass lenses; listed and labeled for use in fire-rated assemblies; adjustable to door thickness, and permitting one-way observation with minimum 150-degree viewing angle.

- D. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.
 - 1. Do not paint silencers.

2.27 AUXILIARY ELECTRIFIED DOOR HARDWARE

- A. Auxiliary Electrified Door Hardware: ANSI/BHMA A156.35.
- B. Door Position Switches: Magnetically operated reed switch designed for concealed mounting.
- C. Door and Frame Transfer Devices: Steel housing for mortise in hinge stile of door, with flexible tube for wiring bundle; accommodating doors that swing open to 120 degrees.

2.28 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.29 FINISHES

- A. Provide finishes complying with ANSI/BHMA A156..
 1. As limited only by available finish options for each product, finishes shall match to greatest extent feasible the following:
 - a. General Door Hardware: ANSI 619/US15: Brushed Satin Nickel.
 2. For hardware not available with finish options meeting above criteria, Architect shall select finishes from manufacturers full range of standard options.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 ELECTRONIC HARDWARE SCOPE OF WORK ASSIGNMENTS:

- A. Unless noted otherwise below, all door hardware and related work shall be the scope of the General Trades Contractor.

1. Door preparation and hardware: General Trades Contractor.
2. Power Transfers and routing to plenum space: General Trades Contractor
3. Back boxes for access control hardware and conduit to plenum: Electric Contractor.
4. Power to power supplies: Electric Contractor.
5. Power Supplies: By Owner's security vendor.
6. Non-lockset-mounted card readers: By Owner's security vendor.
7. Remote door release: By Owner's security vendor.
8. Wiring from ceiling plenum to power supplies: By Owner's security vendor.
9. Programming and Integration: By Owner's security vendor.

3.4 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (760 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (760 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
1. Replace construction cores with permanent cores as directed by Owner.
- F. Key Control System:
1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.

3. Key Control System Software: Set up multiple-index system based on final keying schedule.

- G. Boxed Power Supplies: Shall be provided by Owner'
- H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- I. 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.
- J. 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.
- K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.5 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.6 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.7 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. AUTOMATIC OPERATION HARDWARE Maintenance Service: Beginning at Substantial Completion, maintenance service is to include 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.10 DOOR HARDWARE SCHEDULE

- A. See A-600 Drawings for Hardware Schedules.

END OF SECTION 087111

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for glazed frames.
2. Section 081416 "Flush Wood Doors" for glazed door panels.
3. Section 085413 "Fiberglass Windows" for fiberglass-framed exterior windows.
4. Section 085653 "Security Windows" for ballistic-glazed transaction windows.
5. Section 088813 "Fire Rated Glazing" for fire rated glazing requirements.

1.2 DEFINITIONS

- A. Glass Manufacturers:** Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses:** Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC:** International Building Code.
- D. Interspace:** Space between lites of an insulating-glass unit.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.**

1.4 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 temporary protection requirements for glazing during and after installation.

1.5 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 (300 mm) square.
 - 1. Laminated glass.
 - 2. Insulating glass.
 - 3. Spandrel glass.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturers of fabricated glass units.
- B. Product Certificates: For glass.
- C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.
- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for 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 obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain coated glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
 - 1. Design Wind Pressures:
 - a. Wind Design Data: Inward: 19 psf or 910 Pa
 - b. Outward: 24 psf or 1150 Pa
 - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 - 3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with CPSC 16 CFR Part 1201; Category I for glazing panels ≤ 9 sf; Category II for glazing panels > 9 square feet.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 - 2. For laminated-glass lites, properties are based on products of construction indicated.
 - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. $\times h \times \text{deg F}$ (W/sq. m $\times K$).
 - 5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
 - 6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.
- E. Acoustic Performance:
 - 1. Interior Glazing: 35 STC

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. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm.
- 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. Manufacturers: Subject to compliance with requirements, for all glass types noted below, provide glass products by one of the following:
1. Pilkington North America; NSG Group.
 2. Saint-Gobain Glass Corp.
 3. Vitro Architectural Glass.
 4. Viracon Glazing.
- B. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- C. Low-Iron Annealed Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and enhanced color rendition.
1. Basis of Design: Vitro Architectural Glass, "Acuity" glass
- D. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
- E. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- F. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- G. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
- H. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
- I. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."
- J. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.
- K. Reflective- and Low-E-Coated Spandrel Glass: ASTM C1376, Kind CS.

2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Construction: Laminate glass with interlayer as specified for each glazing type.
 - a. Refer to Section 088853 – "Security Glazing."
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
 1. Sealing System: Dual seal, with polyisobutylene and silicone polyisobutylene and hotmelt butyl polyisobutylene and polyurethane primary and secondary.
 2. Spacer: Aluminum with bronze color finish.
 3. Desiccant: Molecular sieve or silica gel, or blend of both.

2.7 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 of industry colors.

- B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation.
 - c. The Dow Chemical Company.
 - d. Tremco Incorporated.

- C. Structural Adhesive Sealant:

1. Location: At all security-glazing locations.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- C. Setting Blocks:

1. Silicone with Shore A durometer hardness of 85, plus or minus 5.

- D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. Silicone with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing 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 in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do 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.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Low-Iron Glass Type "G": Heat-strengthened.
 - 1. Minimum Thickness: 1/4-inch (6 mm).
- B. Low-Iron Glass Type "T": Fully tempered float glass.
 - 1. Minimum Thickness: 1/4-inch (6 mm).
 - 2. Safety glazing required.
 - 3. Location: See Door and Window Schedules.

3.9 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Clear Insulating Glass Type 'IG.1-R':
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Minimum Thickness of Each Glass Lite: 1/4-inch (6 mm).
 - 3. Outdoor Lite: Enhanced clarity, low-iron heat-strengthened float glass.
 - 4. Interspace Content: Argon.
 - 5. Indoor Lite: Enhanced clarity, low-iron heat-strengthened glass.
 - 6. Low-E Coating: Pyrolytic or sputtered on second surface.
 - 7. Special Treatment: Surface of outer lamination of outdoor lite to be treated by manufacturer with reflective coating to limit visibility to interior.
 - 1. Winter Nighttime U-Factor: 0.38 maximum for full window/door assembly.
 - 2. Visible Light Transmittance: 67 percent minimum.
 - 3. SGHC: 0.36 maximum.
 - 4. Location: South, East & West facades, inaccessible from grade.
 - 5. Refer to Section 088853 "Security Glazing" for type "ISG.1-R" and "ISG.1.P."
- B. Low-E-Coated, Clear Insulating Glass Type 'IG.1-RT':
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Minimum Thickness of Each Glass Lite: 1/4-inch (6 mm).
 - 3. Outdoor Lite: Enhanced clarity, low-iron fully tempered float glass.
 - 4. Interspace Content: Argon.
 - 5. Indoor Lite: Enhanced clarity, low-iron fully tempered float glass.

6. Safety glazing required.
7. Low-E Coating: Pyrolytic or sputtered on second surface.
8. Special Treatment: Surface of outer lamination of outdoor lite to be treated by manufacturer with reflective coating to limit visibility to interior.
9. Winter Nighttime U-Factor: 0.38 maximum for full window/door assembly.
10. Visible Light Transmittance: 67 percent minimum.
11. SGHC: 0.36 maximum.
12. Location: South, East & West facades, inaccessible from grade.
13. Refer to Section 088853 "Security Glazing" for type "ISG.1-R" and "ISG-1.P."

END OF SECTION 088000

SECTION 088813 - FIRE-RATED GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-protection-rated glazing.
 - 2. Fire-resistance-rated glazing.

1.2 DEFINITIONS

- A. Fire-Protection-Rated Glazing: Glazing that prevents spread of fire and smoke and complies with requirements for rated openings; incapable of blocking radiant heat
- B. Fire-Resistance-Rated Glazing: Glazing that prevents spread of fire and smoke and radiant heat and complies with requirements for rated walls and rated openings; capable of blocking radiant heat
- C. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- D. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and glass testing agency.
- B. Product Certificates: For each type of glass and glazing product.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the NGA's Certified Glass Installer Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 FIELD CONDITIONS

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

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of tempered glazing units with clear intumescent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Glass: For each glass type, obtain from single source from single manufacturer.
- B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- 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, glass thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

- A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Low-Iron Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.
- C. Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
 - 2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.

2.5 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. McGrory Glass, Inc.
 - 2. Pilkington North America, NSG Group
 - 3. SAFTI FIRST Fire Rated Glazing Solutions.
 - 4. Technical Glass Products; an Allegion brand.
 - 5. Vetrotech Saint-Gobain.

- B. Products shall meet the required fire protection and fire-resistance rating requirements specified in the documents, and in compliance with IBC Chapter 7 requirements for assembly rating, type, location, maximum glazing size and markings.

2.6 FIRE-PROTECTION-RATED GLAZING

- A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing in accordance with NFPA 257 or UL 9, including hose-stream test, and shall comply with NFPA 80.
 - 1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from hose-stream test.
- B. 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 glazing has passed hose-stream test; whether glazing meets 450 deg F (250 deg C) temperature-rise limitation; and fire-resistance rating in minutes.
- C. 20-MINUTE Fire-Protection-Rated Tempered Glass: 6-mm thickness; fire-protection-rated tempered glass; complying with 16 CFR 1201, Category II.
- D. 45-MINUTE FIRE-PROTECTION-RATED Monolithic Glass for Doors and Protected Openings: 19-mm thickness; low-iron fire-protection-rated glass; complying with 16 CFR 1201, Category II. UL listed and tested in accordance with NFPA 252 for fire-rated doors and NFPA 257 for protected openings with hose-stream testing.
- E. 20-, 45-, 60-, 90- & 120-MINUTE FIRE-PROTECTION-RATED Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 5-mm thickness; faced on one surface with a clear glazing film; complying with 16 CFR 1201, Category II.
- F. 45-MINUTE FIRE-PROTECTION-RATED Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 8-mm total thickness; complying with 16 CFR 1201, Category II.
- G. 45-, 60-, 90- & 120-MINUTE FIRE-PROTECTION-RATED Laminated Glass with Intumescent Interlayer: Laminated glass made from multiple plies of uncoated, low-iron float glass; with intumescent interlayers; complying with 16 CFR 1201, Category II.
- H. 20-, 45-, 60-, 90- & 120-MINUTE FIRE-PROTECTION-RATED Tempered Glazing Units with Clear Intumescent Interlayer: Double glazing units made from two or more lites of uncoated, fully tempered, clear low-iron float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, semi-solid, intumescent polymer; complying with 16 CFR 1201, Category II.

2.7 FIRE-RESISTANCE-RATED GLAZING

- A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing in accordance with ASTM E119 or UL 263.
- B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall

indicate manufacturer's name, test standard, that glazing is approved for use in walls, and fire-resistance rating in minutes.

- C. Fire-Resistance-Rated Framing and Doors: Fire-resistance-rated glazing with 60-, 90-, and 120-minute ratings requires framing and doors from glass supplier, tested as an assembly complying with ASTM E119 or UL 263.
- D. 45-, 60-, 90- & 120-MINUTE FIRE-RESISTANCE-RATED Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, low-iron float glass; with intumescent interlayers; complying with 16 CFR 1201, Category II.
- E. 45-, 60-, 90- & 120-MINUTE FIRE-RESISTANCE-RATED Tempered Glazing Units with Clear Intumescent Interlayer: Glazing units made from two or more lites of uncoated, fully tempered, low-iron float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent polymer; complying with 16 CFR 1201, Category II.

2.8 GLAZING ACCESSORIES

- A. 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.
- B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. The Dow Chemical Company.
 - 2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- C. 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 C1281 and AAMA 800 for products indicated below:
 - 1. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Perimeter Insulation for Fire-Resistance-Rated Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.
- B. 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.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge

damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.

- F. Apply heel bead of elastomeric sealant where required by application.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove non-permanent 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. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088813

SECTION 088853 - SECURITY GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Laminated-glass security glazing
 - 2. Polycarbonate security glazing.
 - 3. Insulating security glazing.
- B. Related Requirements:
 - 1. Section 085413 "Fiberglass Windows" for fiberglass-framed exterior windows.
 - 2. Section 085653 "Security Windows" for ballistic-glazed transaction windows.
 - 3. Section 088000 "Glazing" for general specification information for all glazing including information applicable to Security Glazing.
 - 4. Section 088813 "Fire Rated Glazing" for fire rated glazing requirements.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification:
 - 1. Glazing: Actual sample of finished products for each type of security glazing.
 - a. Size: Manufacturers' standard size.
 - 2. Glazing Accessories: Actual sample of Safety and Security film interlayer
 - 3. Size: Manufacturers' standard size.
- C. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.

1.3 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
 - 1. Product Test Reports:
 - a. For each type of security glazing, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - b. For each type of glazing sealant, for tests performed by a qualified testing agency.

- 1) Provide test reports based on testing current sealant formulations within previous 36-month period.
- B. Qualification Statements: For installers and manufacturers of insulating or air-gap security glazing with sputter-coated, low-e coatings.
- C. Sample warranties.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturers: For insulating or air-gap security glazing units with sputter-coated, low-e coatings, a qualified insulating glazing manufacturer who is approved and certified by coated-glass manufacturer.
 2. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.
 3. 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 type indicated.
 4. Security Glazing Testing Agency: Subject to compliance with requirements, testing agency is one of the following:
 - a. Intertek.
 - b. Underwriters Laboratories, Inc.
 - c. Wiss, Janney, Elstner Associates, Inc.
 5. Sealant Testing Agency: An independent testing agency qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.5 MOCKUPS

- A. Refer to Section 088000 "Glazing"

1.6 PRECONSTRUCTION TESTING

- A. Refer to Section 088000 "Glazing"

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 088000 "Glazing"

1.8 FIELD CONDITIONS

- A. Refer to Section 088000 "Glazing"

1.9 WARRANTY

- A. Special Warranty, Coated Glass: Manufacturer agrees to replace coated glass that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Defects developed in coated glass from normal use that is 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.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Warranty, Laminated-Glass Security Glazing: Manufacturer agrees to replace laminated-glass security glazing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated-glass security glazing 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.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- C. Special Warranty, Glass-Clad Polycarbonate Security Glazing: Manufacturer agrees to replace glass-clad polycarbonate security glazing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass-clad polycarbonate security glazing contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced polycarbonate standard, yellowing, and loss of light transmission.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- D. Special Warranty, Insulating Security Glazing: Manufacturer agrees to replace insulating security glazing that fails in materials and workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Defects in individual lites developed from normal use or failure of hermetic seal under normal use. Defects in individual lites or failure of hermetic seal that is attributed to glass breakage or to maintaining and cleaning insulating security glazing contrary to manufacturer's written instructions are not included.
 - b. Defects in coated-glass lites include peeling, cracking, and other indications of deterioration in coating.

- c. Defects in laminated-glass lites include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - d. Defects in glass-clad polycarbonate lites include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
 - e. Evidence of hermetic seal failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glazing.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of security glazing from single source from single manufacturer.
 - 1. Obtain coated glass from single source from single manufacturer.
- B. Obtain glazing sealants and gaskets from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. Refer to Section 088000 "Glazing"

2.3 SECURITY GLAZING, GENERAL

- A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. Refer to Section 088000 "Glazing"
 - 2. NGA Publications: "Laminated Glazing Reference Manual" and "GANA Glazing Manual."
- B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.
- C. Fire-Test-Response Characteristics of Polycarbonate Sheets: As determined by testing polycarbonate sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.
 - 1. Self-ignition temperature of 650 deg F (343 deg C) or more when tested in accordance with ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
 - 2. Smoke-Developed Index of 450 or less when tested in accordance with ASTM E84 or UL 723, or smoke density of 75 or less when tested in accordance with ASTM D2843 on plastic sheets in thicknesses indicated for the Work.

3. Burning extent of 1 inch (25 mm) or less when tested in accordance with ASTM D635 at a nominal thickness of 0.060 inch (1.52 mm) or thickness indicated for the Work.

- A. Thermal and Optical Performance Properties: Refer to Section 088000 "Glazing"

2.4 GLASS PRODUCTS

- A. Refer to Section 088000 "Glazing"

2.5 LAMINATED-GLASS SECURITY GLAZING

- A. Source Limitations: Glazing conforming to these specifications shall be provided by fiberglass window manufacturer.
- B. Laminated-Glass Security Glazing: ASTM C1172. Two or more glass lites bonded with interlayer. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 2. Interlayer Color: Clear unless otherwise indicated.

2.6 POLYCARBONATE SECURITY GLAZING

- A. Source Limitations: Glazing conforming to these specifications shall be provided by ballistic-rated transaction window manufacturer.
- B. Laminated Glass and Polycarbonate: ASTM C1349. Two or more glass lites and polycarbonate bonded with interlayer. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.7 INSULATING SECURITY GLAZING

- A. Refer to Section 088000 "Glazing" for Insulated Glazing Products to be made part of Insulated Glazing Assemblies.
- B. Insulating Security Glazing: Factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace, qualified in accordance with ASTM E2190

2.8 GLAZING SEALANTS

- A. Refer to Section 088000 "Glazing"
- B. Security Sealant: Manufacturer's standard structural, nonsag, tamper-resistant sealant for joints with low movement complying with ASTM C920, Grade NS, Class 12.5 or 25, Use NT, and with a Shore A hardness of at least 45 when tested in accordance with ASTM C661.

2.9 GLAZING TAPES

- A. Refer to Section 088000 "Glazing"

2.10 MISCELLANEOUS GLAZING MATERIALS

- A. Refer to Section 088000 "Glazing"

2.11 FABRICATION OF SECURITY GLAZING

- A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Grind smooth and polish exposed security glazing edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- 3.2 Refer to Section 088000 "Glazing"

3.3 PREPARATION

- 3.4 Refer to Section 088000 "Glazing"

3.5 GLAZING, GENERAL

- 3.6 Refer to Section 088000 "Glazing"

3.7 TAPE GLAZING

- A. Refer to Section 088000 "Glazing"

3.8 GASKET GLAZING (DRY)

- A. Refer to Section 088000 "Glazing"

3.9 SEALANT GLAZING (WET)

- A. Refer to Section 088000 "Glazing"

3.10 CLEANING AND PROTECTION

- A. Refer to Section 088000 "Glazing"

3.11 LAMINATED-GLASS SECURITY GLAZING SCHEDULE

- A. Security Glazing, Type 'SG': Clear laminated glass.
1. Forced-Entry Resistance, ASTM F1233: Class 1.1 in accordance with ASTM F1233.
 2. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
 3. Maximum Overall Unit Thickness: 3/8-inch (9.5 mm).
 4. STC: 35 minimum.
 5. Safety glazing required.
- B. Security Glazing, Type 'SG-M': Clear laminated glass.
1. Forced-Entry Resistance, ASTM F1233: Class 1.1 in accordance with ASTM F1233.
 2. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
 3. Maximum Overall Unit Thickness: 3/8-inch (9.5 mm).
 4. STC: 35 minimum.
 5. Special Treatment: Glazing to be mirror-coated by manufacturer for one-way visibility.
 6. Safety glazing required.
- C. Security Glazing, Type 'SG-P': Translucent laminated glass.
1. Forced-Entry Resistance, ASTM F1233: Class 1.1 in accordance with ASTM F1233.
 2. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
 3. Maximum Overall Unit Thickness: 3/8-inch (9.5 mm).
 4. STC: 35 minimum.
 5. Special Treatment: Inner surface of lamination to be manufacturer-fabricated satin glazing.
 - a. Level and pattern to be selected by Architect from manufacturer's full range.
 6. Safety glazing required.

3.12 GLASS-CLAD POLYCARBONATE SECURITY GLAZING SCHEDULE

- A. Security Ballistics-resistant Glazing, Type 'B.3' Clear symmetrical glass-clad polycarbonate.
1. Forced-Entry Resistance, ASTM F1233: Class 1.1 in accordance with ASTM F1233.
 2. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
 3. Ballistic Resistance, UL 752: Level 3 in accordance with UL 752.
 4. Maximum Overall Unit Thickness: 1 1/4-inch maximum.
 5. Glazing: Heat-strengthened float glass and polycarbonate interlayers.
 6. Shall be 90-minute fire-rated where indicated.

3.13 INSULATING SECURITY GLAZING SCHEDULE

- A. Source Limitation: Glass materials utilized in construction of Insulated Glazing Units to be sourced from same manufacturer as insulated glazing.

1. Thickness for laminated glass components may vary depending on performance requirements.
 2. Visual appearance and clarity shall match that of corresponding non-security insulated glazing.
- B. Security Glazing, Type 'ISG.1-R': Low-e-coated, clear insulating security glazing. Outdoor lite is made of laminated glass, and indoor lite is made of monolithic glass.
1. Forced-Entry Resistance, ASTM F1233: Class 1.1 in accordance with ASTM F1233.
 2. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
 3. Overall Unit Thickness: 1 inch (25 mm)
 4. Outdoor Lite: Laminated glass with two plies of enhanced clarity, low-iron, heat-strengthened float glass.
 - a. Outer Ply Thickness: 1/8-inch (3 mm).
 - b. Inner Ply Thickness: 1/8-inch (3 mm).
 - c. Interlayer Thickness: 0.060 inch (1.52 mm).
 5. Indoor Lite: Enhanced clarity, low-iron, heat-strengthened float glass.
 6. Interspace Content: Argon.
 7. Low-E Coating: Pyrolytic or sputtered on second surface.
 8. Special Treatment: Surface of outer lamination of outdoor lite to be treated by manufacturer with reflective coating to limit visibility to interior.
 9. Winter Nighttime U-Factor: 0.38 maximum for full window/door assembly.
 10. Visible Light Transmittance: 67 percent minimum.
 11. SGHC: 0.36 maximum.
 12. Location: South, East and West facades, accessible from grade. See Window Schedule.
 13. Safety glazing required.
- C. Security Glazing, Type 'ISG.1-P': Low-e-coated, clear insulating security glazing. Outdoor lite is made of laminated glass, and indoor lite is made of monolithic glass.
1. Forced-Entry Resistance, ASTM F1233: Class 1.1 in accordance with ASTM F1233.
 2. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
 3. Overall Unit Thickness: 1 inch (25 mm)
 4. Outdoor Lite: Laminated glass with two plies of enhanced clarity, low-iron, heat-strengthened float glass.
 - a. Outer Ply Thickness: 1/8-inch (3 mm).
 - b. Inner Ply Thickness: 1/8-inch (3 mm).
 - c. Interlayer Thickness: 0.060 inch (1.52 mm).
 5. Indoor Lite: Enhanced clarity, low-iron, heat-strengthened float glass.
 6. Interspace Content: Argon.
 7. Low-E Coating: Pyrolytic or sputtered on second surface.
 8. Special Treatment: Surface of outer lamination of outdoor lite to be manufacturer-fabricated satin glazing.
 - a. Level and pattern to be selected by Architect from manufacturer's full range.

9. Winter Nighttime U-Factor: 0.38 maximum for full window/door assembly.
 10. Visible Light Transmittance: 60 percent minimum.
 11. SGHC: 0.36 maximum.
 12. Location: See Window Schedule.
- D. Security Glazing, Type 'ISG.2-R': Low-e-coated, clear insulating security glazing. Outdoor lite is made of laminated glass, and indoor lite is made of monolithic glass.
1. Forced-Entry Resistance, ASTM F1233: Class 1.1 in accordance with ASTM F1233.
 2. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
-
3. Overall Unit Thickness: 1 inch (25 mm)
 4. Outdoor Lite: Laminated glass with two plies of enhanced clarity, low-iron heat-strengthened float glass.
 - a. Outer Ply Thickness: 1/8-inch (3 mm).
 - b. Inner Ply Thickness: 1/8-inch (3 mm).
 - c. Interlayer Thickness: 0.060 inch (1.52 mm).
-
5. Indoor Lite: Enhanced clarity, low-iron heat-strengthened float glass.
 6. Interspace Content: Argon.
 7. Low-E Coating: Pyrolytic or sputtered on second surface.
 8. Special Treatment: Surface of outer lamination of outdoor lite to be treated by manufacturer with reflective coating to limit visibility to interior.
 9. Winter Nighttime U-Factor:
 - a. Fixed Glazing: 0.38 maximum for full window/door assembly.
 - b. Operable Glazing: 0.45 maximum for full window/door assembly.
-
10. Visible Light Transmittance: 73 percent minimum.
 11. SGHC: 0.48 maximum.
 12. Location: North facades.

END OF SECTION 088853

SECTION 090190.52 - MAINTENANCE REPAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes maintenance repainting as follows:
 - 1. Removing existing paint.
 - 2. Patching substrates.
- B. Related Requirements:
 - 1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
 - 2. Section 040110 "Masonry Cleaning" for cleaning and removing paint from masonry.
 - 3. Section 099114 "Exterior Painting" for exterior painting MPI systems.
 - 4. Section 099124 "Interior Painting" for interior painting MPI systems.

1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. See Sections 099114 & 099124 for related submittal requirements.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

- C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.
- D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.
- E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
- F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

- A. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Building Restoration Products, Inc.
 - b. PPG Paints; PPG Industries, Inc.
 - c. PROSOCO, Inc.

2.3 PAINT, GENERAL

- A. 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.
- B. Colors: Match Architect's samples.

2.4 PAINT MATERIALS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.5 PAINT MATERIAL MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Paints; PPG Industries.
 - 3. Sherwin Williams.

2.6 PAINT MATERIALS

- A. See Sections 099114 & 099124 for applicable MPI systems.

2.7 PATCHING MATERIALS

- A. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated from weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.
- B. Metal-Patching Compound: Two-part, polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated from corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.
- C. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.
- D. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 MAINTENANCE REPAINTING, GENERAL

- A. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:
 - 1. Remove failed coatings and corrosion and repaint.
 - 2. Verify that substrate surface conditions are suitable for repainting.
 - 3. Allow other trades to repair items in place before repainting.
- B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.
- C. Heat Processes: Do not use torches, heat guns, or heat plates.

3.2 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of painting work. Comply with paint manufacturer's written instructions for inspection.
- B. Maximum Moisture Content of Substrates: Do not begin application of coatings unless moisture content of exposed surface is below the maximum value recommended in writing by paint manufacturer and not greater than the following maximum values when measured with an electronic moisture meter appropriate to the substrate material:
 - 1. Concrete: 12 percent.
 - 2. Gypsum Board: 12 percent.
 - 3. Gypsum Plaster: 12 percent.
 - 4. Masonry (Clay and CMU): 12 percent.
 - 5. Portland Cement Plaster: 12 percent.
 - 6. Wood: 15 percent.
- C. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.

3.3 PREPARATORY CLEANING

- A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.
- B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.
- C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.
- D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.
- E. Chemical Rust Removal:
 - 1. Remove loose rust scale with specified abrasives for ferrous-metal cleaning.
 - 2. Apply rust remover with brushes or as recommended in writing by manufacturer.
 - 3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
 - 4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.

5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with specified abrasives for ferrous-metal cleaning. Clean to bright metal.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.4 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Brushes: Use brushes that are resistant to chemicals being used.
 - a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
 - b. Wood Substrates: Do not use wire brushes.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.
 - a. Equip units with pressure gages.
 - b. Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
 - c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.
 - d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
 - e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material.

C. Paint Removal with Low-Odor, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with water applied by low-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

3.5 SUBSTRATE REPAIR

- A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.
- B. Wood Substrate:
 - 1. Repair wood defects including dents and gouges more than 1/8 inch (3 mm) in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
 - 2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.
- C. Cementitious Material Substrate:
 - 1. General: Repair defects including dents and chips more than 1/2 inch (13 mm) in size and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
 - 2. New and Bare Plaster: Neutralize surface of plaster with mild acid solution as recommended in writing by paint manufacturer. In lieu of acid neutralization, follow manufacturer's written instruction for primer or transition coat over alkaline plaster surfaces.
 - 3. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.
- D. Gypsum-Plaster and Gypsum-Board Substrates:
 - 1. Repair defects including dents and chips more than 1/8 inch (3 mm) in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
 - 2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.
- E. Metal Substrate:
 - 1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust removal method to clean off rust.
 - 2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/8 inch (3 mm) deep or across and all holes and cracks by filling with metal-patching compound and sanding smooth. Remove burrs and protruding fasteners.
 - 3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.6 PAINT APPLICATION, GENERAL

- A. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.
- B. Apply a transition coat over incompatible existing coatings.

- C. Metal Substrate: Stripe paint corners, crevices, bolts, welds, and sharp edges before applying full coat. Apply two coats to surfaces that are inaccessible after completion of the Work. Tint stripe coat different than the main coating and apply with brush.
- D. Blending Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage paint-remover manufacturer's factory-authorized service representative for consultation and Project-site inspection and to provide on-site assistance when requested by Architect.

3.8 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. 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.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.9 SURFACE-PREPARATION SCHEDULE

- A. General: Before painting, prepare surfaces for painting according to applicable requirements specified in this schedule.
 - 1. Examine surfaces to evaluate each surface condition according to paragraphs below.
 - 2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.
 - 3. Repair substrate defects according to "Substrate Repair" Article.
- B. Surface Preparation for MPI DSD 0 Degree of Surface Degradation:
 - 1. Surface Condition: Existing paint film in good condition and tightly adhered.
 - 2. Paint Removal: Not required.
 - 3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Roughen or degloss cleaned surfaces to ensure paint adhesion according to paint manufacturer's written instructions.
- C. Surface Preparation for MPI DSD 1 Degree of Surface Degradation:
 - 1. Surface Condition: Paint film cracked or broken but adhered.
 - 2. Paint Removal: Scrape by hand-tool cleaning methods to remove loose paint until only tightly adhered paint remains.
 - 3. Preparation for Painting: Wash surface by detergent cleaning; use other cleaning methods for small areas of bare substrate if required. Roughen, degloss, and sand the

cleaned surfaces to ensure paint adhesion and a smooth finish according to paint manufacturer's written instructions.

D. Surface Preparation for MPI DSD 2 Degree of Surface Degradation:

1. Surface Condition: Paint film loose, flaking, or peeling.
2. Paint Removal: Remove loose, flaking, or peeling paint film by hand-tool or chemical paint-removal methods.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Use other cleaning methods for small areas of bare substrate if required. Sand surfaces to smooth remaining paint film edges. Prepare bare cleaned surface to be painted according to paint manufacturer's written instructions for substrate construction materials.

E. Surface Preparation for MPI DSD 3 Degree of Surface Degradation:

1. Surface Condition: Paint film severely deteriorated.
2. Paint Removal: Completely remove paint film by hand-tool or chemical paint-removal methods. Remove rust.
3. Preparation for Painting: Prepare bare cleaned surface according to paint manufacturer's written instructions for substrate construction materials.

F. Surface Preparation for MPI DSD 4 Degree of Surface Degradation:

1. Surface Condition: Missing material, small holes and openings, and deteriorated or corroded substrate.
2. Substrate Preparation: Repair, replace, and treat substrate according to "Substrate Repair" Article.
3. Preparation for Painting: Sand substrate surfaces to smooth remaining paint film edges and prepare according to paint manufacturer's written instructions for substrate construction materials. Remove rust.
4. Painting: Paint as required for MPI DSD 2 degree of surface degradation.

3.10 INTERIOR MAINTENANCE REPAINTING SCHEDULE

A. Colors: As indicated on Finishes Schedule.

B. Ferrous Metal Substrates: :

1. Alkyd System: MPI RIN 5.1E system.
 - a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
 - b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
 - c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
 - d. Intermediate Coat: Alkyd, matching topcoat.
 - e. Topcoat: Alkyd, interior, semigloss (Gloss Level 5), MPI #47.

C. Wood Paneling, Casework, Millwork, Trim:

1. Alkyd Enamel System:

- a. Prime Coat: Fully prime coat.
- b. Intermediate Coat: Match topcoat.
- a. Topcoat: Alkyd, interior, semigloss (Gloss Level 5), MPI #47.

D. Painted Concrete Floors:

1. Alkyd Floor Enamel System:

- a. Prime Coat: Fully prime coat.
- b. Intermediate Coat: Match topcoat.
- c. Topcoat: Floor paint, alkyd, low gloss, MPI #59.
- d. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

E. Plaster and Gypsum Surfaces:

1. Low-Odor Latex System over Waterborne Primer: MPI RIN 9.2M system.

- a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
- b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Stain Blocking, Water Based, MPI #137.
- c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Stain Blocking, Water Based, MPI #137.
- d. Topcoat: - Ceilings Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
- e. Topcoat - Walls: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.

END OF SECTION 090190.52

FINISHES SCHEME 'A'

093013	CERAMIC TILING		Size
FT-1	Crossville	Moonstruck Apollo UPS	12x24
FT-2	Crossville	Shades 2.0 Thunder Mosaic 2x2 UPS	M12
WT-1	Crossville	Shades 2.0 Frost Field Tile SPO	12x24
WT-2	Crossville	Shades 2.0 Cool grays, Mosaic 1x3 SPO	M12
WT-3	Crossville	Shades 2.0 Frost Trim SPO	4x24
WT-4	Crossville	Shades 2.0 Frost Cove Base UPS	6x12
095113	RESILIENT TILE FLOORING		
LVT-1	Interface	Studio Set Pewter	25cmx1m
095123	ACOUSTICAL TILE CEILINGS		
ACT-1	Armstrong	Cirrus Second Look Pattern II, Tegular 513	24x48
ACT-2	Armstrong	Acoustical Ceiling Panels Kitchen Zone, 672	24x48
095426	SUSPENDED WOOD CEILING		
ACT-3	Rulon	Acoustical Linear Closed Wood Ceiling Sandpiper	4"W
096513	RESILIENT WALL BASE		
RB-1	Tarkett-Johnsonite	Perceptions, Recess RWDC-TH3, Inkwel	4.25" H
RB-2	Tarkett-Johnsonite	Style B, Recess RWDC-TH3, Inkwel	4"
RB-3	Tarkett-Johnsonite	Match stair/riser covers color	4"
096813	TILE CARPETING		
CPT-1	Interface	Open Air 402 Nickel	25cmx1m
CPT-2	Interface	Open Air 402 Linen	25cmx1m
CPT-3	Interface	Open Air 402 Navy	25cmx1m
CPT-4	Interface	Step Repeat Midnight 104922	50cmx50cm
099123	INTERIOR PAINTING		
P-1	Sherwin Williams	Evening Shadow	-
P-2	Sherwin Williams	Foggy Day	-
P-3	Sherwin Williams	Tin Lizzie	-
P-4	Sherwin Williams	Pure White	-
102113.19	PLASTIC TOILET COMPARTMENTS		
TP-1	Scranton Products	Hiny Hiders Partitions, Orange Peel, Charcoal Gray	-
123216	PLASTIC LAMINATE CASEWORK		
PLAM-1	Wilsonart	Columbian Walnut, 7943	-
PLAM-2	Wilsonart	Pearl Alloy, 5057	-
123661.19	QUARTZ COUNTERTOPS		
QTZ-1	Wilsonart	Fossa Falls	-

FINISHES SCHEME 'B'

093013	CERAMIC TILING		Size
FT-1	Imola	Vibes DG Matte	12x24
FT-2	Aventis	Velvet 2.4x2.4 Mosaic Matte	M12
WT-1	Mosa	Murals Blend Bright White Stonematt	12x24
WT-2	Florida	Enchant Mosaic Beauty M122 Matte	M12
WT-3	Mosa	Murals Blend Bright White Stonematt	6x12
WT-4	Mosa	Same as WT-1	12x24
095113	RESILIENT TILE FLOORING		
LVT-1	Conestogalvt	Patapsco Venice Beach	7"x48"
095123	ACOUSTICAL TILE CEILINGS		
ACT-1	USG	Eclipse Illusion Tegular 78785	24x48
ACT-2	USG	Kitchen Lay-in Panels	24x48
095426	SUSPENDED WOOD CEILING		
ACT-3	Armstrong	Linear Veneered Closed Ceiling Redux Wood Wheat	4"W
096513	RESILIENT WALL BASE		
RB-1	Roppe	Pinnacle Plus, Draft #20, 667 Galactic	4"
RB-2	Roppe	Style B, 667 Galactic	4"
RB-3	Roppe	Match stair/riser covers color	4"
096813	TILE CARPETING		
CPT-1	Mannington	Foam Savory 13138	12"x36"
CPT-2	Mannington	Foam Crisp 11130	12"x36"
CPT-3	Mannington	Foam Rich 14133	12"x36"
CPT-4	Mannington	Frixtion Charge Slide 34368	18"x36"
099123	INTERIOR PAINTING		
P-1	See specification for approved manufacturers; match Scheme A shade		-
P-2	See specification for approved manufacturers; match Scheme A shade		-
P-3	See specification for approved manufacturers; match Scheme A shade		-
P-4	See specification for approved manufacturers; match Scheme A shade		-
102113.19	PLASTIC TOILET COMPARTMENTS		
TP-1	ASI Global	Solid Plastic HDPE, Orange Peel, Charcoal 9237	-
123216	PLASTIC LAMINATE CASEWORK		
PLAM-1	Laminart	Cabinetry Walnut, 992	-
PLAM-2	Laminart	Pearlescence Shadow, 2451	-
			-
123661.16	SOLID SURFACING COUNTERTOP (see note 2)		
SS-1	Cambria	Swanbridge	-

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Framing systems.
 - 2. Suspension systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation reports for embossed steel studs and tracks, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C645 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated
 2. Protective Coating: Comply with ASTM C645; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: ASTM C645.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. ClarkDietrich.
 - c. MarinoWARE.
 2. Minimum Base-Steel Thickness:
 - a. Framing Height less than 11 feet: 0.0190 inch (0.483 mm)
 - b. Framing Height 11 feet or greater: 0.0312 inch (0.793 mm).
 3. Depth:
 - a. As indicated on Drawings.
 - b. Framing Heights greater than 11 feet: 6 inches minimum
- C. Embossed High-Strength Steel Studs and Tracks: Roll-formed with surface deformations to stiffen the framing members.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. MarinoWARE.
 - c. The Mill Steel Co.
 2. Minimum Base-Steel Thickness:
 - a. Framing Height less than 11 feet: 0.0180 inch (0.457 mm).
 - b. Framing Height 11 feet or greater: 0.0312 inch (0.793 mm).
 3. Depth:
 - a. As indicated on Drawings.
 - b. Framing Heights greater than 11 feet: 6 inches minimum.
- D. Slip-Type Head Joints: Where indicated, provide the following:
1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. MRI Steel Framing, LLC.

c. MarinoWARE.

2. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 1-1/2 inches (38 mm).
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels:
 1. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
 2. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
 1. Configuration: Asymmetrical.
- I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 3/4 inch (19 mm).
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 3/4 inch (19 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 AC193 AC58 or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
 - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Furring Channels (Furring Members):

1. Hat-Shaped, Rigid Furring Channels: 7/8 inch (22 mm) deep.
 - a. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
2. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical.

E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armstrong World Industries, Inc.
 - b. Chicago Metallic Corporation.
 - c. USG Corporation.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Z-Shaped Furring Members:
 - 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLATION OF SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

3.4 FIELD QUALITY CONTROL

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal lath.
 - 2. Base-coat cement plaster.
 - 3. Cement plaster finish coats.
 - 4. Accessories.

1.2 ACTION SUBMITTALS

- A. Product data.
- B. Samples: For each type of factory-prepared finish coat and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by a qualified testing agency.

2.2 METAL LATH

- A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
 - 1. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m).

2.3 BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926 for applications indicated.
 - 1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
 - 1. Portland Cement Mixes:

- a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
2. Masonry Cement Mixes:
 - a. Scratch Coat: Mix 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: Mix 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
3. Portland and Masonry Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
4. Plastic Cement Mixes:
 - a. Scratch Coat: Mix 1 part plastic cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: Mix 1 part plastic cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
5. Portland and Plastic Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Base-Coat Mixes for Use over Clay Unit Masonry and Concrete: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:
 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.
- D. Base-Coat Mixes for Use over Concrete Unit Masonry: Single base (scratch) coat for two-coat plasterwork on high-absorption plaster bases as follows:
 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 3. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 4. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

2.4 CEMENT PLASTER FINISH COATS

A. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: Use 1 part masonry cement and 1-1/2 to 3 parts aggregate.
3. Portland and Masonry Cement Mix: For cementitious materials, mix 1 part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
4. Plastic Cement Mix: Use 1 part plastic cement and 1-1/2 to 3 parts aggregate.

B. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Color: As selected by Architect from manufacturer's full range.

C. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1. Color: As selected by Architect from manufacturer's full range.

2.5 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. ClarkDietrich.
 - c. MarinoWARE.
2. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A653/A653M, G60 (Z180) zinc coating.
3. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
4. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
5. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
 - a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
 - b. Smallnose cornerbead with perforated flanges; use on curved corners.
 - c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
 - d. Bullnose cornerbead, radius 3/4 inch (19 mm) minimum, with expanded flanges; use at locations indicated on Drawings.
6. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.

7. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
8. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
9. Two-Piece Expansion Joints: Fabricated from zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

C. Plastic Accessories: Not permitted.

2.6 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, Type II.

1. Color for Finish Coats: Gray.

B. Masonry Cement: ASTM C91/C91M, Type N.

1. Color for Finish Coats: Gray.

C. Plastic Cement: ASTM C1328/C1328M.

D. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match Architect's sample.

E. Lime: ASTM C206, Type S; or ASTM C207, Type S.

F. Sand Aggregate: ASTM C897.

1. Color for Job-Mixed Finish Coats: In color matching Architect's sample.

G. Perlite Aggregate: ASTM C35.

2.7 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in cement plaster.

C. Bonding Compound: ASTM C932.

D. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.

E. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Prepare smooth, solid substrates for plaster in accordance with ASTM C926.
- B. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
- C. Sound-Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

3.2 INSTALLATION OF METAL LATH

- A. Metal Lath: Install in accordance with ASTM C1063.

3.3 INSTALLATION OF ACCESSORIES

- A. Install in accordance with ASTM C1063 and at locations indicated on Drawings.
- B. Reinforcement for External (Outside) Corners:
 - 1. Install cornerbead at exterior locations.
 - 2. Install cornerbead at interior locations.
- C. Control Joints: Locate as indicated on Drawings.

3.4 APPLICATION OF BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926.
- B. Bonding Compound: Apply on unit masonry and concrete substrates for direct application of plaster.
- C. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch (19-mm) total thickness, as follows:
 - 1. Portland and plastic cement mixes.
- D. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 3/4-inch (19-mm) total thickness for metal lath, as follows:
 - 1. Portland and plastic cement mixes.
- E. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 3/8-inch (10-mm) thickness on masonry, as follows:
 - 1. Portland and masonry cement mix.

3.5 APPLICATION OF CEMENT PLASTER FINISH COATS

- A. Plaster Finish Coats: Apply to provide float finish to match Architect's sample.

- B. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- C. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.
- D. Concealed Interior Plasterwork:
 - 1. Where plaster application is concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
 - 2. Where plaster application is concealed above suspended ceilings and in similar locations, omit finish coat.
 - 3. Where plaster application is used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.6 REPAIR

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Acoustical Joint Sealant
- C. Related Requirements:
 - 1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Gypsum wallboard.
 - 2. Gypsum board, Type X.
 - 3. Abuse-resistant gypsum board.
 - 4. Mold-resistant gypsum board.
 - 5. Cementitious backer units.
 - 6. Interior trim.
 - 7. Joint treatment materials.
 - 8. Laminating adhesive.
 - 9. Acoustical sealant.

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 C840 requirements or gypsum board manufacturer's written instructions, 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, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. National Gypsum Company.
 - c. USG Corporation.
 - 2. Thickness: 5/8 inch (15.9 mm).
 - 3. Long Edges: Tapered.
- B. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. National Gypsum Company.
 - c. USG Corporation.
 - 2. Core: 5/8 inch (15.9 mm), Type X, unless indicated otherwise on drawings.

3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. National Gypsum Company.
 - c. USG Corporation.
2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. James Hardie Building Products, Inc.
 - b. National Gypsum Company.
 - c. USG Corporation.
2. Thickness: 5/8 inch (15.9 mm).
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Install where indicated on drawings to be exposed to view and not receive joint compound.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. Fry Reglet Corporation.
 - c. Pittcon Industries.
3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.
4. Finish: Clear anodized.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints 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 setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Acoustical Joint Sealant:
1. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
 2. Provide Products by one of the following:
 - a. Pecora Corporation
 - b. Tremco Incorporated
 - c. USG Corporation
 3. Install acoustical joint sealant at the following locations for partitions scheduled for Sound-Attenuation Blankets:
 - a. Along edges of floor and ceiling track framing
 - b. Along edge of stud framing where it abuts an adjacent wall surfaces
- E. Thermal and Acoustic Insulation: As specified in Section 072100 "Thermal and Acoustic Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. 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 C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical surfaces indicated on drawings unless noted to receive one of the other types listed below.
 - 2. Abuse-Resistant Type: As indicated on Drawings.
 - 3. Mold-Resistant Type: As indicated on Drawings.
 - 4. Acoustically Enhanced 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 vertically (parallel 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-shaped 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 (400 mm) 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-shaped 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.
- 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 instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

3.5 INSTALLATION OF 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 at locations indicated on Drawings or according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
 3. U-Bead: Use at exposed panel edges in contact with exterior wall surfaces or other surfaces subject to moisture migration not indicated to receive aluminum trims.

- D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 4. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Cementitious Backer Units: 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 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Ceramic tile.
 - 2. Porcelain tile.
 - 3. Thresholds.
 - 4. Waterproof membranes.
 - 5. Crack isolation membranes.
 - 6. Metal edge strips.

- B. Related Requirements:

- 1. Section 035413 "Gypsum Cement Underlayment"
 - 2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Section 090600 "Finishes Schedule" for color selections for each product.
 - 4. Section 092900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Module Size: Actual tile size plus joint width indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

2. Full-size units of each type of trim and accessory.
3. Stone thresholds in 6-inch (150-mm) lengths.
4. Metal edge strips in 6-inch (150-mm) lengths.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.
- C. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

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 TWO (2) full cases for each type, composition, color, pattern, and size installed.
 2. Grout: Furnish TWO (2) full units of color-mixed grout for each color installed.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of floor tile installation.
 2. Build mockup 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 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 Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Waterproof membrane.
 - 2. Crack isolation membrane.
 - 3. Metal edge strips and transitions.

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.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. FT-1, OPTION 1

1. Basis of Design Product: Subject to compliance with requirements, provide **Crossville Tile, "Moonstruck Collection."**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 12in X 24in
4. Face Size Variation: Rectified.
5. Thickness: 10.5 mm
6. Face: UPS
7. Dynamic Coefficient of Friction: 0.50-0.60.
8. Tile Colors: Apollo
9. Tile Pattern: Running Bond; As noted in drawings.

B. FT-1, OPTION 2

1. Basis of Design Product: Subject to compliance with requirements, provide **Imola Tile, "Vibes Collection."**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 12in X 24in
4. Face Size Variation: Rectified.
5. Thickness: 10 mm
6. Face: Matte
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Colors: DG
9. Tile Pattern: Running Bond; As noted in drawings.

C. FT-2, OPTION 1

1. Basis of Design Product: Subject to compliance with requirements, provide **Crossville Tile, "Shades 2.0 Collection."**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 2in X 2in Mosaic
4. Face Size Variation: Rectified.
5. Thickness: 9.5 mm
6. Face: UPS
7. Dynamic Coefficient of Friction: 0.50-0.60.
8. Tile Colors: Thunder
9. Tile Pattern: Stacked; As noted in drawings.

D. FT-2, OPTION 2

1. Basis of Design Product: Subject to compliance with requirements, provide **Florida Tile, "Aventis Collection."**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 12in X 24in
4. Face Size Variation: Rectified.
5. Thickness: 9 mm
6. Face: Matte
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Colors: Velvet

9. Tile Pattern: Stacked; As noted in drawings.

E. WT-1, OPTION 1

1. Basis of Design Product: Subject to compliance with requirements, provide **Crossville Tile, "Shades 2.0 Collection"**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 12in X 24in
4. Face Size Variation: Rectified.
5. Thickness: 9.5 mm
6. Face: SPO
7. Dynamic Coefficient of Friction: 0.42-0.52.
8. Tile Colors: Frost
9. Tile Pattern: Running Bond; As noted in drawings.

F. WT-1, OPTION 2

1. Basis of Design Product: Subject to compliance with requirements, provide **Mosa Tile, "Murals Blend Collection"**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 12in X 24in
4. Face Size Variation: Rectified.
5. Thickness: 10 mm
6. Face: StoneMatt
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Colors: Bright White
9. Tile Pattern: Running Bond; As noted in drawings.

G. WT-2, OPTION 1

1. Basis of Design Product: Subject to compliance with requirements, provide **Crossville Tile, "Shades 2.0 Collection."**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 1in X 3in Mosaic
4. Face Size Variation: Rectified.
5. Thickness: 9.5 mm
6. Face: SPO
7. Dynamic Coefficient of Friction: 0.42-0.52.
8. Tile Colors: Cool Grays
9. Tile Pattern: Stacked; As noted in drawings.

H. WT-2, OPTION 2

1. Basis of Design Product: Subject to compliance with requirements, provide **Florida Tile, "Enchant Collection"**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: M122 Mosaic
4. Face Size Variation: Rectified.
5. Thickness: 9 mm
6. Face: Matte
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Colors: Beauty
9. Tile Pattern: Stacked; As noted in drawings.

I. WT-3, OPTION 1

1. Basis of Design Product: Subject to compliance with requirements, provide **Crossville Tile, "Shades 2.0 Collection."**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 4in X 24in Single Bullnose Trim
4. Face Size Variation: Rectified.
5. Thickness: 9.5 mm
6. Face: SPO
7. Dynamic Coefficient of Friction: 0.42-0.52.
8. Tile Colors: Frost
9. Tile Pattern: Horizontally Stacked; As noted in drawings.

J. WT-3, OPTION 2

1. Basis of Design Product: Subject to compliance with requirements, provide **Mosa Tile, "Murals Blend Collection"**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 6in X 12in
4. Face Size Variation: Rectified.
5. Thickness: 7 mm
6. Face: Stonematt
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Colors: Bright White
9. Tile Pattern: Horizontally Stacked; As noted in drawings.

a. In lieu of Bullnose (Not available), installer to provide continuous metal edge profile per typical tile details

K. WT-4, OPTION 1

1. Basis of Design Product: Subject to compliance with requirements, provide **Crossville Tile, "Shades 2.0 Collection."**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 6in X 12in Cove Base
4. Face Size Variation: Rectified.
5. Thickness: 9.5 mm
6. Face: UPS
7. Dynamic Coefficient of Friction: 0.5-0.6.
8. Tile Colors: Frost
9. Tile Pattern: Horizontally Stacked; As noted in drawings. Coordinate with ID Drawings.

L. WT-4, OPTION 2

1. Basis of Design Product: Subject to compliance with requirements, provide **Mosa Tile, "Murals Blend Collection"**
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 12in X 24in
4. Face Size Variation: Rectified.
5. Thickness: 10 mm
6. Face: Stonematt
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Colors: Bright White
9. Tile Pattern: Running Bond; As noted in drawings.

- a. In lieu of Cove Base (Not available), installer to provide continuous metal wall base cove profile per typical tile details

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 (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

2.5 WATERPROOF / ANTI-FRACTURE MEMBRANES

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Manufacturers: Subject to compliance with the requirements of this section, provide products by one of the following manufacturers comparable to basis of design products specified below:
 1. Laticrete.
 2. MAPEI.
 3. Custom Building Products.
- C. Locations:
 1. Install below all floor tile locations to 8 inches above adjacent floor surface.
 2. Install behind all wall tile in shower areas. Coordinate flashing into floor membrane.
- D. Waterproof Anti-Fracture Membrane, Self-Adhered, Sheet-Applied, rated for large format porcelain floor tile and certified for use with tile provided.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Mapeguard 2.
 2. Nominal Thickness: 0.040 inch (1 mm).
 3. Provide manufacturer-recommended Primer for proper adhesion to substrate.
- E. Waterproof Anti-Fracture Membrane, Fabric-Reinforced, Fluid-Applied: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement, rated for large format porcelain floor tile and certified for use with tile provided.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Aquadefense.

2.6 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

1. Manufacturer: Subject to compliance with requirements, provide named product by one of the following specified manufacturers:
 - a. Laticrete; "254 Platinum"
 - b. MAPEI; "UltraFlex LFT"
 - c. Custom Building Products; "VersaBond-LFT Mortar"
2. For floor tile installation over existing concrete substrate.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI 118.4.
4. Provide prepackaged dry mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at the Project site.

2.7 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. LATICRETE SUPERCAP, LLC; "Permacolor".
 - b. MAPEI Corporation; Kerapoxy IEG CQ or Ultracolor® Plus.
2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
3. Color to be selected by Architect from manufacturer's full color line.

B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. LATICRETE SUPERCAP, LLC; "Spectralock Pro".
 - b. MAPEI Corporation; Kerapoxy CQ.
2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.
3. Use Epoxy grout at all floor tile installations and wall tile in wet areas.
4. Color to be selected by Architect from manufacturer's full color line.

2.8 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. Basis-of-Design Products: Subject to compliance with requirements, provide the following products or products by Alternate Manufacturer comparable in quality, physical configuration, material and appearance to Basis-of-Design products listed below:
1. Manufacturer: Schluter Systems, L.P.
 2. Alternate Manufacturer: Progress Profiles Systems S.p.A.
 3. Alternate Miscellaneous Materials manufacturers and/or products will be considered under the following conditions:
 - a. Manufacturer information and detailed product data, that meets or exceeds the basis-of-design product manufacturer's specifications and performance criteria, along with full size samples are provided to the Architect two weeks prior to the bid proposal submission date.
 - b. Proposed products comply with requirements identified in the specifications and drawings for the Project.
 - c. Proposed products are available to meet the project schedule and can be supplied in sizes and profiles as specified and noted in the Project documents.
 - d. Samples of all miscellaneous materials to be provided for the Project, in colors and finishes closely matching specified products, are submitted with the initial request for review by the Architect in accordance with schedule noted above.
 - e. Follow substitution requirements identified in the bid solicitation for the Project. If accepted, the products will be identified in an addendum approving the products to be included as part of the Contract Documents and issued to all bidders.
- C. Movement Joint and Cove Profile:
1. Schluter; "DILEX- AKWS" movement joint.
 - a. Integrated aluminum, trapezoid-perforated anchoring legs, connected by grip bars to ¼ inch (6 mm) wide soft PVC movement zone.
 - 1) Size for indicated floor tile installation.
 - 2) Color: G – Grey
 - b. Install in accordance with manufacturer's written instructions.
 2. Schluter; "DILEX-EKE" cove profile.
 - a. Integrated rigid PVC trapezoid-perforated anchoring legs, connected to a 90-degree angle by a 3/16 inch (5 mm) wide soft CPE movement zone that forms the visible surface.
 - 1) Size for indicated floor and wall tile installations.
 - 2) Color: G – Grey
 - b. Install in accordance with manufacturer's written instructions.

D. Wall and Corner Profiles:

1. Schluter; "QUADEC" edge protection.
 - a. Square visible surface with integrated trapezoid-perforated anchoring legs and integrated grout joint spacer.
 - 1) Size for indicated wall tile installations.
 - 2) Color: AT – Satin nickel anodized aluminum.
 - b. Provide matching outside corners and connectors.
 - c. Install in accordance with manufacturer's written instructions.

E. Transition Edge between Tile and Carpet or Tile and Resilient Flooring:

1. Same Height Transition:
 - a. Schluter; "SCHIENE" equal height transition profile with minimal reveal.
2. Sloped Transitions: Tile to Carpet:
 - a. Schluter; "RENO-TK" sloped transition profile covering lower surface.
3. Sloped Transitions: Ceramic Tile to Resilient Tile:
 - a. Schluter, "RENO-U" sloped transition profile abutting both surfaces.
4. Size for adjacent flooring thickness(es).
5. Color: AT – Satin nickel anodized aluminum.
6. Install in accordance with manufacturer's written instructions.

F. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.

G. 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.

H. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.9 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. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 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 (200 by 200 mm) 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 (3.2 mm).
 - 2. Porcelain Tile: 1/4 inch (6.4 mm) or 3/8 inch (9.5 mm) according to manufacturer's recommendations.
- 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. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
 2. Do not extend cleavage membrane, waterproof membrane, or crack isolation membrane under thresholds set in modified dry-set or improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on with elastomeric sealant.
- K. Metal Edge Strips: Install at locations indicated 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 WATERPROOF AND CRACK ISOLATION MEMBRANES

- A. Install waterproof membrane to comply with ANSI A108.13 and ANSI A108.17 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 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.

3.6 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.

3.7 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F121 and ANSI A108.1C; cement mortar bed (thickset) on waterproof membrane.
 - a. Ceramic Tile Type: 2X2 or similar Ceramic Mosaic Floor Tile.
 - b. Bond Coat for Cured-Bed Method: Standard dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - 2. Ceramic Tile Installation: TCNA F125-Full, except where partial coverage is indicated; thinset mortar on crack isolation membrane.
 - a. Ceramic Tile Type: Porcelain Floor Tile.
 - b. Thinset Mortar: Latex-Portland Cement mortar.
 - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Masonry or Concrete:
 - 1. Ceramic Tile Installation: TCNA W202; thinset mortar.
 - a. Ceramic Tile Type: Porcelain Wall Tile.
 - b. Thinset Mortar: Latex-Portland Cement mortar.
 - c. Grout: Water-cleanable epoxy grout.
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Ceramic Tile Type: Porcelain Wall Tile.
 - b. Thinset Mortar: Latex-Portland Cement mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustical panels.
 - 2. Metal suspension system.
 - 3. Metal edge moldings and trim.

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 exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed for each product.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 1 percent of quantity installed for each product.

1.7 PRODUCTS DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage

from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class B in accordance with ASTM E1264.
 - 2. Smoke-Developed Index: 450 or less.
- B. Acoustical Panel Standard: Manufacturer's standard panels in accordance with ASTM E1264.

2.2 ACOUSTICAL PANELS "ACT-1"

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong Ceiling & Wall Solutions; Cirrus Second Look, Pattern II, Tegular 513
 - 2. USG Corporation; Eclipses Illusion, Tegular 78785
- B. Color: White.
- C. Light Reflectance (LR): Not less than 0.85.
- D. Ceiling Attenuation Class (CAC): Not less than 35.
- E. Noise Reduction Coefficient (NRC): Not less than 0.65.
- F. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.
- G. Thickness: 3/4 inch (19 mm).
- H. Modular Size: 24 by 48 inches (610 by 1220 mm).

2.3 ACOUSTICAL PANELS "ACT-2"

- A. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong Ceiling & Wall Solutions; Kitchen Zone, 672
 - b. USG Corporation; Kitchen Lay-in Panels
- B. Color: White.
- C. Light Reflectance (LR): Not less than 0.75.

- D. Ceiling Attenuation Class (CAC): Not less than 30.
- E. Noise Reduction Coefficient (NRC): Not less than 0.55.
- F. Edge/Joint Detail: Square, Lay-in.
- G. Thickness: 5/8 inch (16 mm).
- H. Modular Size: 24 by 48 inches (610 by 1220 mm).

2.4 METAL SUSPENSION SYSTEM

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong Ceiling & Wall Solutions; 15/16" Prelude XL Exposed Tee Suspension System.
 - 2. USG Corporation; 15/16" DX/DXL Suspension System..
- B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M.
- 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 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
 - 1. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 2. Face Design: Flat, flush.
 - 3. Cap Material: Cold-rolled steel or aluminum.
 - 4. Cap Finish: Painted to match color of acoustical unit.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified

in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.

10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

END OF SECTION 095113

SECTION 095426 - SUSPENDED WOOD CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid wood, linear-panel ceilings.

1.2 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each product.
- B. Shop Drawings: For suspended wood ceilings.
 - 1. Include reflected ceiling plans, sections, and details, drawn to scale.
- C. Samples: For each exposed product and for each type, color, and finish specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rulon International.
2. Armstrong World Industries, Inc.

- B. Source Limitations:
1. Provide products from single manufacturer.

2.2 GENERAL

1. Surface-Burning Characteristics: Provide products with the following characteristics when tested in accordance with ASTM E84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2.3 SOLID-WOOD, LINEAR-PANEL CEILINGS – **ACT3**

- A. Solid-Wood Linear Closed Ceiling Panels: Manufacturer's standard linear panels fabricated from kiln-dried solid-wood planks without finger joints, cracks, checks, or warp. Planks run parallel to panel length.
1. Plank Species: White Oak.
 2. Plank Cut: Manufacturer's standard.
 3. Plank Width: 4 inches (102 mm).
 4. Plank Depth: 3/4 inch (19 mm).
 5. Plank Length: Variable.
 6. Plank Edges:
 - 1) ACT3 Option 1: Rulon - Square
 - 2) ACT3 Option 2: Armstrong - Notched
 7. Reveal/Plank Spacing:
 - 1) ACT3 Option 1: Rulon - 3/4 inch (19 mm) between long edges of planks
 - 2) ACT3 Option 2: Armstrong - None
 8. Panel Attachment: Provide manufacturer's standard metal spring clips for attaching panels to grid suspension system, spaced to support ceiling and in accordance with manufacturer's written installation instructions.
 - a. Plank Finish:
 - 1) ACT3 Option 1: Rulon - Sandpiper.
 - 2) ACT3 Option 2: Armstrong - Redux Wood Wheat
 - b. Plank Gloss: Satin.
- B. Linear-Ceiling-Panel Accessories: Linear-ceiling-panel manufacturer's accessories required to provide a complete installation of ceiling in accordance with manufacturer's written installation instructions.
1. Acoustic Felt: Manufacturer's standard, factory applied, black, backer with flame-spread index of 25 or less and smoke-developed index of or less as determined by testing in accordance with ASTM E84.

2. End Caps: Manufacturer's standard units for exposed field-cut edges; solid wood finished to match planks.
 3. Wood Trim: Manufacturer's standard solid wood finished to match planks; with trim connectors recommended in writing by ceiling and suspension-system manufacturers.
- C. Grid Suspension System: ASTM C635/C635M; recommended in writing by ceiling and suspension-system manufacturers for applications indicated; main- and cross-runner system complete with suspension-system components required to support ceiling units and other ceiling-supported construction.

2.4 SUSPENSION-SYSTEM HANGERS, BRACES, AND TIES

- A. 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 provide not less than 0.135-inch- (3.4-mm-) diameter wire.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Measure each ceiling area and establish layout of suspended wood ceilings.
1. Balance border widths at opposite edges of each ceiling.
 2. Avoid using less-than-half-width units.
- B. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- C. 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 (76 mm). 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. 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.
 6. Space hangers not more than 48 inches (1219 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (203 mm) from ends of each member.

7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- D. Install edge moldings and trim at perimeter of ceiling area and where necessary to conceal edges and ends of wood units.
 1. Do not use exposed fasteners on moldings and trim.
- E. Grid Suspension Systems: Space main beams at 48 inches (1219 mm) o.c.
 1. Install cross tees to form modules sized in accordance with manufacturer's written installation instructions.
 2. Remove and replace dented, bent, or kinked members.
- F. Linear-Carrier Suspension Systems: Install carriers at no more than 24 inches (610 mm) o.c. 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.
- G. Install wood components and accessories in accordance with manufacturer's written instructions and to accommodate natural expansion and contraction of wood products resulting from fluctuations in humidity.
- H. Cut wood components for accurate fit at borders and at interruptions and penetrations by other work through ceilings.
 1. Stiffen edges of cut wood components as required to eliminate variations in flatness.
- I. Treat field-cut edges of wood components in accordance with manufacturer's written recommendations; finish exposed field cuts to match factory finish.
- J. Install wood components in coordination with suspension system and moldings and trim.
 1. Install wood components in patterns indicated on Drawings.
- K. Install field-constructed access panels in locations indicated on Drawings.
- L. Clean exposed surfaces of ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented units.

END OF SECTION 095426

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 090600 "Finishes Schedule" for color selections for each product.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubber wall base.
 - 2. Rubber stair accessories.
 - 3. Vinyl molding accessories.
 - 4. Vinyl corner guards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Samples for Initial Selection: For each type of product indicated.

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. Rubber Wall Base: Two (2) full coils (approximately 100 - 120 feet) for each color used in the project.
 - 2. Rubber Stair Treads: One (1) full carton for each color used. Length to be longest utilized in project.
 - 3. Metal Stair Nosings: Four (4) units. Length to be longest utilized in project.
 - 4. Vinyl Molding: One (1) full carton for each color and profile used in the project.
 - 5. Vinyl Corner Guards: One (1) full carton for each color used in the project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Johnsonite; a Tarkett company; RB-1 thru RB-3, Option 1.
 - 2. Roppe Corporation; Roppe Holding Company; RB-1 thru RB-3, Option 2.
- B. Designer Wall Base "RB-1."
 - 1. Product Standard: ASTM F 1861, Type TS (thermoplastic rubber, vulcanized thermoset), Group I (solid, homogeneous), Style A.
 - 2. Thickness: 0.125 inch (3.2 mm).
 - 3. Height:
 - a. RB-1, Option A – 4.25 inches (108 mm).
 - b. RB-1, Option B - 4 inches (102 mm).
 - 4. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
 - 5. Outside Corners: Preformed.
 - 6. Inside Corners: Preformed.
 - 7. Styles and Colors:
 - a. RB1 Option 1 – Johnsonite – Perceptions, Recess RWDC-TH3, "Inkwell."
 - b. RB1 Option 2 – Roppe – Pinnacle Plus, Draft #20, 667 "Galactic."

C. Standard Wall Bases "RB-2" & "RB-3"

1. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous), Style B.
 - a. Style: Cove.
2. Thickness: 0.125 inch (3.2 mm).
3. Height: 4 inches (102 mm).
4. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
5. Outside Corners: Job formed or preformed.
6. Inside Corners: Job formed or preformed.
7. Colors:
 - a. RB-2, Option A – Johnsonite – TH3 - "Inkwell" – 4"
 - b. RB-3, Option A – Johnsonite 667 "Galactic" – 4"
 - c. RB-2, Option B – Roppe – Match rubber stair treads – 4"
 - d. RB-3, Option B – Roppe–Match rubber stair treads – 4"

2.2 RUBBER STAIR ACCESSORIES

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Johnsonite; a Tarkett company.
 2. Roppe Corporation; Roppe Holding Company.
- C. Stair Treads: ASTM F2169.
 1. Type: TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).
 2. Class: 2 (pattern; embossed).
 3. Group: 1 (embedded abrasive strips).
 4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
 5. Nosing Height: 1-1/2 inches (38 mm).
 6. Thickness: 1/4 inch (6 mm) and tapered to back edge.
 7. Size: Lengths and depths to fit each stair tread in one piece.
 8. Color: As selected by Architect from manufacturer's full non-custom color selection.
 9. Pattern: As selected by Architect from manufacturer's full selection.
- D. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
 1. Style: Coved toe, 7 inches (178 mm) high by length matching treads.
 2. Thickness: Manufacturer's standard.
 3. Color: As selected by Architect from manufacturer's full non-custom color selection.

E. Stair Nosings:

1. Type: TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).
2. Style: Slim-reveal profile.
3. Thickness: 1/4 inch (6 mm) and tapered to back edge.
4. Size: Lengths and depths to fit each stair tread in one piece.
5. Color: As selected by Architect from manufacturer's full non-custom color selection including metallic options.

F. Locations: Provide rubber stair accessories in areas indicated on drawings.

2.3 VINYL MOLDING ACCESSORY

- A. Manufacturer: Provide products from the same manufacturer as selected for base.
- B. Description: Vinyl carpet edge for glue-down applications where carpet/resilient tile transitions to concrete/fluid-applied flooring, carpet transitions to resilient tile flooring, and between resilient tile flooring of different heights.
- C. Profile and Dimensions: As indicated, or if not indicated using manufacturers standard products.
- D. Locations: Provide vinyl molding accessories in areas indicated or if not indicated as required to provide a finished transition or termination of flooring materials.
- E. Colors and Patterns: As selected by Architect from manufacturer's full line of standard colors and patterns.

2.4 VINYL CORNER GUARDS

- A. Manufacturer: Provide products from the same manufacturer as selected for base.
- B. Description: Vinyl carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet, transition strips, other misc. accessories as required for a finished installation.
- C. Profile and Dimensions: "VCG"
1. Return Length: 2-1/4 inches (57 mm) to 2-3/8 inches (60 mm).
 2. Height: 48 inches (1220 mm) to 54 inches (1370 mm).
 3. Thickness: 0.125 inch (3 mm).
- D. Locations: Provide vinyl corner guards in areas indicated on drawings or if not indicated as required to provide a finished transition or termination of flooring materials.
- E. Colors and Patterns: As selected by Architect from manufacturer's full line of standard colors and patterns.

2.5 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches (50.8 mm) wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products 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 products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base including minimum conditioning times.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CORNER GUARD INSTALLATION

- A. Comply with manufacturer's written instructions for installing corner guards.
- B. Following surface preparation, Install guards with manufacturer-approved adhesive directly above the top of the wall base.
- C. Apply corner guards at locations noted on drawings and at locations as directed by the Architect.

3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Luxury Vinyl floor Tile (LVT).

B. Related Sections:

1. Section 024119 "Selective Demolition."
2. Section 035413 "Gypsum Cement Underlayment"
3. Section 035416 "Hydraulic Cement Underlayment."
4. Section 090600 "Finishes Schedule" for color selections for each product.
5. Section 096513 "Resilient Base and Accessories"

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of floor tile indicated.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

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 TWO (2) boxes in original packaging and balance of remainder of tiles in open packages for each type, color, pattern, and size of resilient product 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. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). 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 (21 deg C) or more than 95 deg F (35 deg C), 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 (13 deg C) or more than 95 deg F (35 deg C).

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 LUXURY VINYL FLOOR TILE: LVT-1 OPTION 1

A. Basis-of-Design Product: Subject to compliance with requirements, provide:

1. **Interface, Studio Set, "Pewter."**

B. Tile Standard: ASTM F1700.

1. Class: Class III.
2. Type A: Printed Surface.

C. Thickness: 4.5 mm.

D. Size: 25 cm by 1 m.

E. Installation: Per Finish Floor Plans

2.2 LUXURY VINYL FLOOR TILE: LVT-1 OPTION 2

A. Basis-of-Design Product: Subject to compliance with requirements, provide:

1. **Conestoga LVT, Patapsco, "Venice Beach"**

B. Tile Standard: ASTM F1700.

1. Class: Class III.
2. Type A: Printed Surface.

C. Thickness: 5 mm.

D. Size: 7in X 48in

E. Installation: Per Finish Floor Plans

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.

C. Floor Polish: If recommended by manufacturer, provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of 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 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 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 10 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. 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.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. 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.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated and as directed by Architect.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

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 marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply only if recommended by manufacturer.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Modular carpet tile.

- B. Related Requirements:

- 1. Section 024119 "Selective Demolition" for removing existing floor coverings.
 - 2. Section 035413 "Gypsum Cement Underlayment"
 - 3. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
 - 4. Drawing ID-601 "Material Schedule" for ceramic tile products and colors selected for project.

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- (300-mm-) 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. (8.3 sq. m).

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups at locations scheduled to receive carpet.
2. 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: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE – GENERAL

- A. Color and Pattern: Match Architect's samples as listed in Finish Schedule.
- B. Yarn System: 100 percent recycled nylon
- C. Color System: 100% solution dyed.
- D. 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.
- E. Performance Characteristics:
 - 1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D7330.
 - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
 - 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
 - 4. Delamination: No delamination in normal use.
 - 5. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
 - 6. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
 - 7. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
 - 8. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 CARPET TILE CPT-1, OPTION 1

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Interface, LLC; “Open Air Collection, product line Open Air 402 – Nickel 106741”**, or similar product and pattern by Interface, LLC.
- B. Construction: Tufted Textured Loop.
- C. Backing System: “GlasBac Tile”.
- D. Size: Modular 25cm X 1m.
- E. Installation: Ashlar

2.3 CARPET TILE CPT-1, OPTION 2

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Mannington Mills, Inc. “Crafted Collection, product line Form Savory 13138”**, or similar product and pattern by Mannington Mills, Inc.
- B. Construction: Patterned Loop.
- C. Backing System: “Infinity 2 Tile”.
- D. Size: Modular 12in X 36in
- E. Installation: Ashlar

2.4 CARPET TILE CPT-2 OPTION 1

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Interface, LLC; “Open Air Collection, product line Open Air 402 – Linen 106744”**, or similar product and pattern by Interface, LLC.

- B. Construction: Tufted Textured Loop.
- C. Backing System: "GlasBac Tile".
- D. Size: Modular 25cm X 1m.
- E. Installation: Ashlar

2.5 CARPET TILE CPT-2, OPTION 2

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Mannington Mills, Inc. "Crafted Collection, product line Form Crisp 11130"**, or similar product and pattern by Mannington Mills, Inc.
- B. Construction: Patterned Loop.
- C. Backing System: "Infinity 2 Tile".
- D. Size: Modular 12in X 36in.
- E. Installation: Ashlar

2.6 CARPET TILE CPT-3, OPTION 1

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Interface, LLC; "Open Air Collection, product line Open Air 402 – Navy 107691"**, or similar product and pattern by Interface, LLC.
- B. Construction: Tufted Textured Loop.
- C. Backing System: "GlasBac Tile".
- D. Size: Modular 25cm X 1m.
- E. Installation: Ashlar

2.7 CARPET TILE CPT-3, OPTION 2

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Mannington Mills, Inc. "Crafted Collection, product line Form Rich 14133"**, or similar product and pattern by Mannington Mills, Inc.
- B. Construction: Patterned Loop.
- C. Backing System: "Infinity 2 Tile".
- D. Size: Modular 12in X 36in
- E. Installation: Ashlar

2.8 CARPET TILE CPT-4, OPTION 1

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Interface, LLC; “Step Repeat Collection, product line SR899 Midnight 104922”**, or similar product and pattern by Interface, LLC.
- B. Construction: Tufted Textured Loop.
- C. Backing System: “GlasBac Tile”.
- D. Size: Modular 50cmX50cm.
- E. Installation: Ashlar

2.9 CARPET TILE CPT-4, OPTION 2

- A. Basis-of-Design Product: Subject to compliance with requirements, **provide Mannington Mills, Inc. “Frixion Collection, product line; “Charge Colorways Slide 34368”**, or similar product and pattern by Mannington Mills, Inc.
- B. Construction: Patterned Loop.
- C. Backing System: “Infinity 2 Tile”.
- D. Size: Modular 18in X 36in
- E. Installation: Ashlar

2.10 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.

- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- 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 (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. 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: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Install pattern as indicated on drawings or directed by Architect.

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 096813

SECTION 099114 - EXTERIOR PAINTING (MPI STANDARDS)

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. Surface preparation and application of paint systems on the following exterior substrates:
 - a. Concrete.
 - b. Clay masonry.
 - c. Concrete masonry units (CMUs).
 - d. Steel and iron.
 - e. Galvanized metal.
 - f. Aluminum (not anodized or otherwise coated).
 - g. Plastic.
 - h. Portland cement plaster (stucco).
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 2. Section 099300 "Staining and Transparent Finishing" for surface preparation and application of wood stains and transparent finishes on exterior wood substrates.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include preparation requirements and application instructions.
- B. Samples: For each type of topcoat product.

- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Paints; PPG Industries, Inc.
 - 3. Sherwin-Williams Company (The).
- B. Source Limitations: Obtain paint from single source from single manufacturer.

2.2 PAINT PRODUCTS

- A. MPI Standards: Provide products complying with MPI standards indicated and 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 topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect.

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 CMUs): 12 percent.
 - 3. Portland Cement Plaster: 12 percent.

- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- 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 and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- 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 paints.
- H. Aluminum Substrates: Remove loose surface oxidation.

3.3 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view:
 - 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.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

- 1. Latex over Latex Aggregate System, MPI INT 3.1B:
 - a. Prime Coat: Textured coating, latex, flat, MPI #42.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

B. Concrete Substrates, Traffic Surfaces:

- 1. Alkyd Floor Enamel System MPI EXT 3.2D:
 - a. Prime Coat: Floor enamel, matching topcoat.
 - b. Intermediate Coat: Floor enamel, matching topcoat.
 - c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6), MPI #27.
 - d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
- 2. Clear Sealer System MPI EXT 3.2G:
 - a. Prime Coat: Sealer, solvent based, matching topcoat.
 - b. Intermediate Coat: Sealer, solvent based, matching topcoat.
 - c. Topcoat: Sealer, solvent based, for concrete floors, MPI #104.

C. Clay Masonry Substrates:

- 1. Latex System MPI EXT 4.1A:
 - a. Prime Coat: Latex, exterior, matching topcoat.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: As selected by Architect.
 - 1) Flat Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.
 - 2) Low-Sheen Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.
 - 3) Semigloss Topcoat: Latex, exterior, semigloss (MPI Gloss Level 5), MPI #11.
 - 4) Gloss Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

D. CMU Substrates:

- 1. Latex over Alkali-Resistant Primer System MPI EXT 4.2L:
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: As selected by Architect.
 - 1) Flat Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.
 - 2) Low-Sheen Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.
 - 3) Semigloss Topcoat: Latex, exterior, semigloss (MPI Gloss Level 5), MPI #11.
 - 4) Gloss Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

E. Steel and Iron Substrates:

- 1. Alkyd System MPI EXT 5.1D:
 - a. Alkyd Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Shop Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - d. Topcoat: As selected by Architect.
 - 1) Flat Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.
 - 2) Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5), MPI #94.
 - 3) Gloss Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

F. Galvanized-Metal Substrates:

- 1. Alkyd System MPI EXT 5.3B:
 - a. Prime Coat: Primer, galvanized, cementitious, MPI #26.
 - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - c. Topcoat: As selected by Architect.
 - 1) Flat Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.
 - 2) Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5), MPI #94.
 - 3) Gloss Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

G. Aluminum Substrates:

- 1. Alkyd System MPI EXT 5.4F:
 - a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
 - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - c. Topcoat: As selected by Architect.
 - 1) Flat Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.
 - 2) Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5), MPI #94.
 - 3) Gloss Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

H. Stainless Steel Substrates:

- 1. Alkyd System MPI EXT 5.6A:

- a. Prime Coat: Vinyl wash primer, MPI #80.
 - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - c. Topcoat: As selected by Architect:
 - 1) Flat Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.
 - 2) Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5), MPI #94.
 - 3) Gloss Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.
- I. Fiberglass Substrates:
- 1. Alkyd System MPI EXT 6.7B:
 - a. Prime Coat: Primer, bonding, solvent based, MPI #69.
 - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - c. Topcoat: As selected by Architect.
 - 1) Flat Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.
 - 2) Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5), MPI #94.
 - 3) Gloss Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.
- J. Plastic Trim Fabrication Substrates:
- 1. Alkyd System MPI EXT 6.8B:
 - a. Solvent-Based Prime Coat: Primer, bonding, solvent based, MPI #69.
 - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - c. Top Coat: As selected by Architect.
 - 1) Flat Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.
 - 2) Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5), MPI #94.
 - 3) Gloss Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.
- K. Portland Cement Plaster Substrates:
- 1. Latex System MPI EXT 9.1J:
 - a. Alkali-Resistant Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Flat Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

END OF SECTION 099114

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Clay masonry.
 - 3. Concrete masonry units (CMUs).
 - 4. Steel and iron.
 - 5. Aluminum (not anodized or otherwise coated).
 - 6. Wood.
 - 7. Fiberglass.
 - 8. Plastic.
 - 9. Gypsum board.
 - 10. Plaster.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 2. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Label each coat of each Sample.
 - 2. Label each Sample for location and application area.
- D. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 1 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Paints; PPG Industries, Inc.
 - 3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- 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 indicated in a color schedule.

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 CMUs): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.

- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.

- e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
- 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
- 1. Latex over Latex Aggregate System, MPI INT 3.1B:
 - a. Prime Coat: Textured coating, latex, flat, MPI #42.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
- B. Concrete Substrates, Traffic Surfaces:
- 1. Latex Floor Enamel System, MPI INT 3.2A:

- a. Prime Coat: Floor paint, latex, matching topcoat.
- b. Intermediate Coat: Floor paint, latex, matching topcoat.
- c. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3), MPI #60.

C. Clay Masonry Substrates:

1. Institutional Low-Odor/VOC Latex System, MPI INT 4.1M:

- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: As selected by Architect
 - 1) Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.
 - 2) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.
 - 3) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
 - 4) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.
 - 5) Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level 5), MPI #147.

D. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System, MPI INT 4.2E:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: As selected by Architect.
 - 1) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
 - 2) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.
 - 3) Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level 5), MPI #147.

E. Steel Substrates:

1. Water-Based Dry-Fall System, MPI INT 5.1C: **EXPOSED CEILING DECKS AND FRAMING.**

- a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
- b. Prime Coat: Shop primer specified in Section where substrate is specified.
- c. Topcoat: Dry fall, latex, flat, MPI #118.

2. Alkyd System, MPI INT 5.1E: **CONTACT SURFACES AND MISCELLANEOUS EXPOSED STEEL.**

- a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
- b. Prime Coat: Shop primer specified in Section where substrate is specified.
- c. Intermediate Coat: Alkyd, interior, matching topcoat.
- d. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level 5), MPI #47.

F. Galvanized-Metal Substrates:

1. Water-Based Light-Industrial Coating System, MPI INT 5.3B:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light-industrial coating, interior, water based, semigloss (MPI Gloss Level 5), MPI #153.

G. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. High-Performance Architectural Latex System, MPI INT 5.4F:
 - a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: As selected by Architect.
 - 1) Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 2) Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 3) Topcoat: Latex, interior, high performance architectural, semigloss (MPI Gloss Level 5), MPI #141.

H. Wood Substrates: **WOOD PANELING, TRIM AND PAINTED CASEWORK.**

1. Alkyd System, MPI INT 6.4B:
 - a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level 5), MPI #47.

I. Wood Substrates: **TRAFFIC SURFACES, INCLUDING PAINTED FLOORS, LANDINGS AND STAIRS.**

1. Alkyd Floor Enamel System, MPI INT 6.5A:
 - a. Prime Coat: Floor enamel, alkyd, matching topcoat.
 - b. Intermediate Coat: Floor enamel, alkyd, matching topcoat.
 - c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6), MPI #27.

J. Fiberglass Substrates:

1. Institutional Low-Odor/VOC Latex System, MPI INT 6.7J:
 - a. Prime Coat: Primer, bonding, solvent based, MPI #69.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: As selected by Architect.

- 1) Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.
- 2) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.
- 3) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
- 4) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.
- 5) Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level 5), MPI #147.
- 6) Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

K. Plastic Substrates:

1. Institutional Low-Odor/VOC Latex System, MPI INT 6.8F:

- a. Prime Coat: Primer, bonding, solvent based, MPI #69.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: As selected by Architect.
 - 1) Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.
 - 2) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.
 - 3) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
 - 4) Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.
 - 5) Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level 5), MPI #147.
 - 6) Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

L. Gypsum Board and Plaster Substrates:

1. Institutional Low-Odor/VOC Latex System, MPI INT 9.2M:

- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat - **CEILINGS**: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.
- d. Topcoat – **NON-CORRIDOR WALLS**: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

2. High-Performance Architectural Latex System, MPI INT 9.2B: **CORRIDOR WALLS**

- 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 (MPI Gloss Level 3), MPI #139.

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Primers
 - 2. Wood stains.
 - 3. Transparent finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of finish system and in each color and gloss of finish required.
- C. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MOCKUPS

- A. Wood Flooring: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects and to set quality standards for materials and execution.

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. PPG Paints; PPG Industries, Inc.
 - 3. Sherwin-Williams Company (The).

2.2 MATERIALS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

- A. Alkyd Sanding Sealer, Interior, Solvent Based, Clear: Solvent-based, quick-drying, clear, sandable alkyd sealer used on new interior wood surfaces that are to be top-coated with an alkyd varnish.

2.4 WOOD STAINS

- A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.

2.5 TRANSPARENT FINISHES

- A. Varnish, Interior, Polyurethane, Oil Modified, Satin: Solvent-based, one-component, oil-modified polyurethane clear satin varnish for new or previously varnished or stained interior wood surfaces.
 - 1. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.

3.2 PREPARATION

- A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood Substrates, Wood Flooring and Stair Treads.
 - 1. Polyurethane Varnish over Stain System:
 - a. Stain Coat: Stain, semitransparent, for interior wood.
 - b. First Intermediate Coat: Polyurethane varnish matching topcoat.
 - c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
 - d. Topcoat: Varnish, interior, polyurethane, oil modified, satin.
 - 2. Polyurethane Varnish System:
 - a. Prime Coat: Polyurethane varnish matching topcoat.
 - b. Intermediate Coat: Polyurethane varnish matching topcoat.
 - c. Topcoat: Varnish, interior, polyurethane, oil modified, satin.
- B. Wood Substrates, Hardwood Shelving
 - 1. Polyurethane Varnish System:
 - a. Prime Coat: Polyurethane varnish matching topcoat.
 - b. Intermediate Coat: Polyurethane varnish matching topcoat.
 - c. Topcoat: Varnish, interior, polyurethane, oil modified, satin.

END OF SECTION 099300

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Room-identification signs that are directly attached to the building.
 - 2. Nonilluminated message-strip directories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification 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, including raised characters and Braille, and layout for each sign at least half size Insert scale.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design," the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. 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. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic or phenolic backing sheet to produce composite sheet. UV-stable.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
 - b. Surface-Applied Graphics:
 - 1) Symbols/Text: Tactile acrylic; 1/32 inch raised.
 - c. Subsurface Graphics: Slide-in changeable insert where applicable.
 - d. Color(s):
 - 1) Field Face: Color selected by Architect from Manufacturer's non-custom color range.
 - 2) Background: Color selected by Architect from Manufacturer's non-custom color range.
 - 3) Symbols/Text: Color selected by Architect from Manufacturer's non-custom color range.
 - e. Braille: Where specified on signage schedule and per A117.1/ADA requirements.
 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
 3. Mounting: Surface mounted to wall with two-face tape and perimeter sealant.

2.3 NONILLUMINATED MESSAGE-STRIP DIRECTORIES

- A. Metal Frame: Directory with full perimeter metal frame and sheet metal rear cover, housing changeable message strips in configuration indicated.
1. Perimeter Frame:
 - a. Material: Extruded aluminum.
 - b. Profile: Square.
 - c. Corners: **Square**.
 - d. Depth: Manufacturer's standard **1-3/4- to 2-3/4-inch (44- to 70-mm) frame depth**.
 2. Cover: [Non-sectional single-piece cover with full-length concealed hinge, full width of directory.][Cover for each section of message strips with full-length concealed hinge.

- a. Frame: Same material and finish as perimeter frame.
 - b. Hinge Location: [Side] [Top, with hold-open bracket] [Top, with gas-cylinder hold-open].
 - c. Glazing: [Clear float glass] [Clear tempered glass] [Bronze-tinted tempered glass] [Gray-tinted tempered glass] [Clear acrylic sheet].
 3. Number of Columns: One column of message strips.
 4. Mounting: Surface.
 5. Header Panel: Full width of directory by **6 inches (152 mm)** high.
 6. Divider Strips: Provide divider strips between columns of message strips, and between header and message strips.
 - a. Color: As selected by Architect from Manufacturer's full range of non-custom colors.
 7. Aluminum Finish: Clear anodic or Color anodic.
 - a. Color: As selected by Architect from Manufacturer's full range of non-custom colors.
- B. Message Strips: Provide message strips compatible with directory system selected, with message copy indicated in message-strip schedule.
 1. Type:
 - a. Acrylic or high-pressure plastic-laminate strips with machine- or laser-engraved copy, which exposes contrasting core.
 2. Width: Match frame.
 3. Height: Up to 3 inches.
 4. Color:
 - a. Message-Strip Background: As selected by Architect from Manufacturer's full range of non-custom colors.
 - b. Lettering: Color: As selected by Architect from Manufacturer's full range of non-custom colors..
 5. Lettering:
 - a. Size: As selected by Architect.
 - b. Font Style: As selected by Architect.
 - c. Case: All capitals.
 6. Header Graphics: Provide copy that complies with requirements indicated on **artwork supplied on electronic media by Architect** for size, style, spacing, content, height, location, material, and colors of graphics.
 7. Directory Overall Width: Up to **24 inches (610 mm)**.
 8. Directory Overall Height: Up to **36 inches (914 mm)**.

2.4 SIGNAGE SCHEDULE:

- A. See project drawings for signage types, graphics and locations.

2.5 SIGN MATERIALS

- A. Aluminum Sheet and Plate: **ASTM B209** (**ASTM B209M**), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: **ASTM B221** (**ASTM B221M**), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.].
- E. 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.

2.6 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 sign unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
- B. Adhesive: Per sign manufacturer's recommendations.
- C. Sealant: Clear silicone caulking.
- D. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch** (**1.14 mm**) thick, with adhesive on both sides.
- E. Backer Plates: Where any sign is installed on glazed surfaces, provide an identical-sized and colored blank backer plate installed on opposite side of glazing aligned with opposite side.

2.7 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 3. 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.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. **Furnish two blank inserts for each sign for Owner's use.**

2.8 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.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **Class I, 0.018 mm** or thicker.
- B. Color Anodic Finish: AAMA 611, **Class I, 0.018 mm** or thicker.

PART 3 - EXECUTION

3.1 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.

B. Mounting Methods:

1. Concealed 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 sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. 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.
3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 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 101423.16

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for blocking.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.
3. Section 090600 "Finishes Selection Schedule" for colors and finishes selected for project.

1.2 COORDINATION

- A.** Coordinate requirements for blocking, reinforcing, and other supports concealed within wall to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-plastic toilet compartments:
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.

- C.** Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.

- D.** Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturer's standard size.

- E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.
- F. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For toilet compartments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hinges: Four hinge(s) with associated fasteners.
 - 2. Latch and Keeper: Two latch(es) and keeper(s) with associated fasteners.
 - 3. Door Bumper: Two bumper(s) with associated fasteners.
 - 4. Door Pull: Two door pull(s) with associated fasteners.
 - 5. Fasteners: 20 fasteners of each size and type.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain plastic toilet compartments from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
 - 1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf (1112 N) applied at any direction and at any point, without deformation of panel.

- C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

2.3 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Scranton Products, 'Eclipse' partitions or comparable product by one of the following:
 - 1. ASI Global Partitions.
 - 2. Bradley Corporation.
- B. Toilet-Enclosure Style: Overhead braced and Floor anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color throughout thickness of material.
 - 1. Integral Hinges: Configure doors and pilasters to receive concealed integral hinges.
 - 2. Heat-Sink Strip: Manufacturer's continuous, extruded-aluminum or stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 - 3. Color: One color in each room as selected by Architect from manufacturer's full range.
 - 4. Edges: Shiplap, zero sight-line.
- E. Urinal-Screen Construction: Matching panel construction.
- F. Pilaster Shoes: Manufacturer's standard design
- G. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.
- H. Colors:
 - 1. Charcoal Gray – Orange peel finish

2.4 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.
 - 1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick, stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through bolts.
 - 2. Latch and Keeper with Occupancy Indicator on exterior surface: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts. Units to have occupancy indicator activated when latched.

3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through bolts.
 4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at out-swinging doors. Mount with through bolts.
 5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221 (ASTM B221M).
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.
- E. Zamac: ASTM B86, commercial zinc-alloy die castings.

2.6 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet enclosures and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels or Screens: Shiplap within manufacturer's tolerance.
 - b. Panels or Screens and Walls: 1 inch (25 mm).
 - 2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust, so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out swinging doors to return doors to fully closed position.

END OF SECTION 102113.19

SECTION 102641 – BULLET-RESISTANT FIBERGLASS PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Bullet-resistant fiberglass wall panels.

1.2 REFERENCES

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment.
- B. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass.
- C. ASTM E119-98-Standard Test Methods for Fire Tests of Building Construction and Materials,
- D. MIL-P-46593A-Numerical simulation of ballistic impact on composite laminates,
- E. MIL-STD-622F-V50 Ballistic Test for Armor.

1.3 ACTION SUBMITTALS

- A. Product Data: Including manufacturer recommended installation instructions.
- B. Shop Drawings: Include plans, elevations, sections, details, attachment to other work.
- C. Samples: For each product.

1.4 INFORMATION SUBMITTALS

- A. Product Test Reports: Indicating compliance with requirements
- B. Warranty: Sample of warranty

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations provided by manufacturer. Do not install products stored in conditions outside manufacturer's recommended limits.

1.7 WARRANTY

- A. Workmanship Warranty: All materials shall be warranted against defects for a period of 10 years for the date of receipt at the project site. Provide certificates of manufacturer's standard limited warranty with closeout documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
1. Total Security Solutions, Inc.; 935 Garden Lane, Fowlerville, MI 48836; (866) 734-6277; www.tssbulletproof.com.
 2. Waco Composites; 302 S. 27th St., Waco, TX 76710; (866) 688-3088 phone; www.armorcore.com

2.2 BULLET RESISTANT ALL GLASS GLAZING

- A. Bullet Resistant Fiberglass panels made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets.
- B. Performance Level:
1. Fiberglass will be rated and tested for UL 752 and NIJ—0108.01 at the Level indicated by the product selected.
 2. UL752 Standard for Bullet Resisting Equipment – Level 3, Paragraph 4.5
 3. National Institute of Ballistic Standards NIJ0108.01– Level IIIA
 4. One Hour Fire Rating Per ASTM E119-98
 5. Class IV Forced Entry Protection Rating Per ASTM F1233-98
- C. Thickness: 7/16-inches, minimum.

2.3 FABRICATION

- A. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning installation, verify that areas have been prepared as required by the Contract Documents and architectural drawings, and Shop Drawings have been approved.
- B. Notify Architect of any unsatisfactory preparation that is responsibility of others.
- C. Clean and prepare all surfaces per manufacturers recommendations as required for achieving the best results for the substrate under the project conditions.

- D. Do not begin installation of material until all unsatisfactory conditions have been resolved and approved by Architect.

3.2 INSTALLATION

- A. Do not begin installation until areas have been verified and surfaces properly prepared in accordance with Drawings.
- B. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb.
- C. Apply sealant in accordance with manufacturer's recommendations as indicated in installation instructions.
- D. Remove excess sealant and leave exposed surfaces clean and smooth.
- E. Cut and install panels according to manufacturer's recommendations.

3.3 PROTECTION

- A. Clean and protect material from damage during ongoing construction operations. If damage occurs, remove and replace as required to provide voice ports in their original, undamaged condition.
- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements.
- C. Provide final cleaning of product and accessories, removing excess sealant, labels and protective covers.
- D. Touch-up, repair or replace damaged products prior to Substantial Completion.

END OF SECTION

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Childcare accessories.
 - 4. Under-lavatory guards.
 - 5. Custodial 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.
- C. Coordinate mounting requirements and locations for Owner-Supplied accessories.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Childcare accessories.
 - 4. Underlavatory guards.
 - 5. Custodial accessories.
- B. Product Data Submittals: For each 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.
- C. 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 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 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: 15 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish the following extra accessories that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:
 - 1. Electric Hand Dryer: One (1).
 - 2. Grab Bars: One (1) each of 18", 36" and 42" lengths.
 - 3. Mirror: One (1).
 - 4. Shower curtain rod: Two (2) including all fittings necessary for replacement.
 - 5. Shower curtain: Four (4) curtains for EACH shower installed.
 - 6. Robe hooks: Four (4).

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials:
 - 1. Toilet Paper Dispensers
 - 2. Paper Towel Dispensers
 - 3. Soap Dispensers
 - 4. Free-standing Trash Receptacles

- B. The contractor shall coordinate and install owner supplied accessories including blocking and other mounting materials necessary for a complete installation.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.
 - 2. Shower Seats: Installed units are able to resist 360 lbf (1601 N) concentrated load applied in any direction and at any point.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.
- B. High-Speed Air Hand Dryer:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Dyson Inc.
 - f. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - g. Saniflow Corporation; Mediclinics S.A.
 - 2. Description: High-speed, warm-air hand dryer for rapid hand drying.
 - 3. Mounting: Surface mounted.
 - a. Protrusion Limit: Installed unit protrudes maximum 4 inches (102 mm) from wall surface.
 - 4. Operation: Infrared-sensor activated with timed power cutoff switch.
 - a. Average Dry Time: 12 seconds.
 - b. Automatic Shutoff: At 60 seconds.
 - 5. Maximum Sound Level: 69 dB.
 - 6. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - 7. Electrical Requirements: 115 V, 20 A, 2300 W.

C. Grab Bars:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. OD: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings and required by field conditions.

D. Mirror Units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
2. Frame: Stainless steel channel.
 - a. Corners: Welded and ground smooth.
3. Size: As indicated on Drawings.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

2.4 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.
- B. Shower Curtain Rod:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.

- b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
 2. Description: 1-1/4-inch- (32-mm-) OD, straight rod.
 3. Configuration: As indicated on Drawings.
 4. Mounting Flanges: Concealed fasteners; in material and finish matching rod.
 5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- C. Shower Curtain:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
 2. Size: Minimum 6 inches (152 mm) wider than opening by 72 inches (1829 mm) high.
 3. Material: Duck, minimum 8 oz. (227 g), white, 100 percent cotton.
 4. Color: As selected from manufacturer's full range.
 5. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
 6. Shower Curtain Hooks: Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
- D. Folding Shower Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
 2. Configuration: L-shaped seat, designed for wheelchair access.
 3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
 4. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 5. Dimensions: Coordinate with shower stall manufacturer for size and mounting.
- E. Folding Bathtub Seat – Keynote 10.28.11:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
2. Configuration: Folding in-tub bathtub seat that folds against the wall when not in use.
 3. Seat — Phenolic core
 4. Frame — Zinc-plated 3/4" (19mm) diameter steel pipe 1/10" (2.5mm) wall thickness. 1/8" (3mm) thick W1 white vinyl antibacterial, biocompatible, and warm-to-the-touch coating thickness; 1-5/16" (33mm) outside diameter
 5. Mounting Mechanism: Wall plate Type 304, thickness 1/8" (3mm) stainless steel. Mounting Flange Cover polyamide 6 nylon with glossy finish.
 6. Bracket — Zinc-plated 3/4" (19mm) steel tubing with vinyl antibacterial, biocompatible, and warm-to-the-touch coating thickness.
 7. Dimensions: Minimum nominal seat size of 15" X 29" with overall dimensions of 17" X 32".

F. Robe Hook:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
2. Description: Double-prong unit. Style as selected by Architect from manufacturer's full line.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.5 CHILDCARE ACCESSORIES

- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.

B. Diaper-Changing Station:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bradley Corporation.
 - c. Diaper Deck & Co.
 - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - e. Koala Kare Products; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.

2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250 lb (113 kg) static load when opened.
3. Mounting: Surface mounted, with unit projecting not more than 4 inches (102 mm) from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: HDPE with plastic-laminate insert in color selected by Architect.
6. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

2.6 UNDERLAVATORY GUARDS

A. Underlavatory shield:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Buckaroos, Inc.
 - b. Plumberex Specialty Products, Inc.
 - c. Truebro; IPS Corporation.
2. Description: Removable, one-piece, wall-mounted shield contoured to underside of basin.
3. Material and Finish: Antimicrobial, molded plastic. Color as selected by Architect from manufacturer's full line.

2.7 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Custodial Mop and Broom Holder:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. ASI-American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: Approximately 36 inches (914 mm)
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.8 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) 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- (0.9-mm-) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) 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.

2.9 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 in accordance with 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.
- C. Shower Seats: 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 in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

B. Warranty: Manufacturer's standard warranty.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 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. Guardian Fire Equipment, Inc.
 - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - c. Larsen's Manufacturing Company.
- B. Cabinet Construction: Match host wall fire-resistance rating.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Recessed Cabinet:
 - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
- E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
 - 1. Square-Edge Trim: **1-1/4- to 1-1/2-inch (32- to 38-mm)** backbend depth.
- F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- G. Cabinet Trim Material: Same material and finish as door.
- H. Door Material: Stainless steel sheet.
- I. Door Style: Full acrylic bubble with frame.
- J. Door Glazing:
 - 1. Exterior Locations: Break acrylic sheet
 - 2. Interior Locations: Tempered glass sheet
 - 3. Interior Locations where extinguisher size requires bubble: Molded acrylic bubble
 - 4. Acrylic Sheet Color:
 - a. Clear transparent acrylic sheet.
 - 5. Glass Sheet Color: Clear, transparent.

6. Acrylic Bubble Color: Clear, transparent.
- K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
1. Provide manufacturer's standard.
 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- L. 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. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Manufacturer's Standard
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- M. Materials:
1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Architect from manufacturer's full range.
 2. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.
 - a. Finish: ASTM A480/A480M No. 4 directional satin finish,
 3. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
 4. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with.

2.4 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. Miter corners and grind smooth.
 - 3. 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.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch (13 mm)** thick.
 - 2. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "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 unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed and semirecessed 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 indicated or, if not indicated, at height indicated below:
 - 1. Fire-Protection Cabinet Mounting Height: 42 inches (1067 mm) above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
 - 1. Apply decals or vinyl lettering at locations indicated.

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 104413

SECTION 104416 - FIRE EXTINGUISHERS

1.1 SUMMARY

A. Section Includes:

1. Portable fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets" for storage of portable fire extinguishers where not indicated for standard wall mounting.

1.2 ACTION SUBMITTALS

- #### **A. Product Data:** For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- #### **A. Warranty:** Manufacturer's standard warranty.

1.4 CLOSEOUT SUBMITTALS

- #### **A. Operation and maintenance data.**

1.5 COORDINATION

- #### **A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.**

1.6 WARRANTY

- #### **A. Special Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- #### **A. NFPA Compliance:** Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet 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. Guardian Fire Equipment, Inc.
- b. Kidde; Carrier Global Corporation.
- c. Larsen's Manufacturing Company.
- d. Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America.

- 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

- B. INTERIOR, CONDITIONED AREAS:

- 1. **Stored-Pressure Water Type: UL-rated 2-A**, 2.5-gal. (9.5-L) nominal capacity, with water in stainless-steel container; with pressure-indicating gage.
- 2. **Stored-Pressure Water Type: UL-rated 4-A**, 5-gal. (9.5-L) nominal capacity, with water in stainless-steel container; with pressure-indicating gage.

- C. OUTDOOR AND UNCONDITIONED SPACES:

- 1. **Stored-Pressure, Antifreeze Water Type: UL-rated 2-A**, 2.5-gal. (9.5-L) nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as minus 40 deg F (minus 40 deg C) in stainless-steel container; with pressure-indicating gage.

- D. COMMERCIAL KITCHENS:

- 1. **Stored-Pressure, Wet-Chemical Type: UL-rated Class-K**, 6-liter nominal capacity, with potassium-acetate-based wet chemical in manufacturer's stainless steel container.

- E. ELECTRONICS AND COMPUTER ROOMS:

- 1. **Carbon Dioxide Type: UL-rated 5-B:C**, 5-lb (2.3-kg) nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

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. Guardian Fire Equipment, Inc.
 - b. Kidde; Carrier Global Corporation.
 - c. Larsen's Manufacturing Company.
 - d. Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
- C. Locations: Where no fire protection cabinets are indicated on Life Safety or Floor Plans, provide manufacturer's standard wall mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
 1. Mounting Height: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

END OF SECTION 104416

SECTION 105123 – STORAGE LOCKERS AND BENCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Lockers.
- B. Locker benches.

1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry: Anchorage/blocking for attachment of lockers

1.3 REFERENCES

- A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Drawings shall be submitted showing individual locker size and overall dimensions.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company regularly engaged in manufacture of products specified in this section, and whose products have been in satisfactory use under similar service conditions for not less than 5 years.
- B. Installer Qualifications: A company regularly engaged in installation of products specified in this Section, with a minimum of 5 years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Locker components shall be stored flat until assembly. All finishes shall be protected from soiling and damage during handling.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

- A. Warranty: Manufacturer guarantees its plastic against breakage, corrosion, and delamination under normal conditions for 15 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. (Labor not included in warranty.)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Scranton Products; Tufftec Lockers
 - 2. Bradley Corporation; Lenox Lockers
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 LOCKERS

- A. Design: Solid plastic storage locker.
 - 1. Vertical Stack: One Tier
 - 2. Passes NFPA 286.
- B. Size: Individual and stack height as indicated on drawings.
 - 1. Locker Depth: 24 inches (381 mm).
 - 2. Locker Width: 18 inches (381 mm).
 - 3. Locker Height: 72 inches (1143 mm)
- C. Hardware:
 - 1. Plastic Coat Hook: Top-mounted, two-pronged plastic coat hook.
 - 2. Padlock hasp.
 - 3. Horizontal venting.
 - 4. Continuous hinge.
 - 5. Top: Slope top.
 - 6. Base.
 - 7. End panel.
- D. Locker Bases: Supplied 4 inches (102 mm) high, black unless otherwise specified. Fabricated from 3/4 or 1 inch (19 or 25 mm) black plastic. Bases are assembled in the field.

2.3 CONSTRUCTION

- A. Locker Doors and Frames: Made from high impact, high density polyethylene (HDPE) formed under high pressure into solid plastic components 1/2 inch (13 mm) thick with homogeneous color throughout.
- B. Sides, Tops, Bottoms, Backs, and Shelves: Made from high impact, high density, polyethylene (HDPE) formed under pressure into solid plastic components 3/8 inch (9.5 mm) thick with homogeneous natural color throughout. Vertical back, outside, inside panels, horizontal top, bottom, divider, and shelves will be grey in color.

- C. End Panels: Filler panels of plastic material in color of locker unless noted otherwise as an accent color.
- D. Continuous Latch: Made from high impact HDPE plastic and capable of accepting various locking mechanisms. The spring-loaded latch shall be securely fastened to the entire length of the door providing a quiet positive latching function.
- E. Door Hinge: Heavy duty zinc-plated steel. Full length, assembled onto door and locker front.
- F. Assembly Profile: To be full height of lockers. Made from PVC plastic and snapfit assembled onto locker sides.
- G. Assembly Profile: To be full height of lockers. Profile to be tongue-and-groove joint construction using 3/8 inch thick HDPE.
- H. Coat Hooks: Two-prong, high impact plastic. Mounted to bottom of shelf or divider. One each per door opening.

2.4 MATERIALS

- A. Lockers to be constructed from High Density Polyethylene (HDPE) resins.
 - 1. Resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments.
- B. HDPE Components: To have a smooth "orange peel" finish. Locker doors and door frames to be the same color.
 - 1. Color: As selected from manufacturer's standard colors.

2.5 FABRICATION

- A. Locker Components: Fabricated square and rigid with a finish free of scratches and chips.
- B. Solid Plastic Locker Components: Snap together at profile connections or slide together at dovetail connections for easy assembly and provide a solid and secure anti-racking bookcase component construction for clean lines and precise reveals. Adjacent lockers share a common side panel. Locker units are manufactured for assembly in a group of no more than three adjacent lockers.

2.6 BENCHES

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Scranton Products; Tufftek Bench
 - 2. Bradley Corporation; Lenox Bench
 - 3. Global Industrial; ADA Locker Room Bench
- B. Design: Floor-mounted pedestal.
 - 1. Bench Tops: 1-1/4 inches (32 mm) thick with all edges rounded.
 - 2. Depth: 20 inches to 24 inches
 - 3. Length: 42 inches.
 - 4. Back: No
 - 5. Pedestals: 16 inches (406 mm) high, and secured to bench tops with stainless steel tamper resistant Torx head screws and secured to floor using lead expansion shields with 2 inch (51 mm) stainless steel Phillips head machine bolts.
- C. Bench Top Color: As selected by Architect from manufacturer's full selection.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Report discrepancies to the architect.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers at the location shown in accordance with the manufacturers' instructions for plumb, level, rigid and flush installations.
- C. Anchor the units to the wall studs through the locker back and to the floor using 1-1/2 inches (38 mm) tapcon screws.
- D. Lockers shall be floor-mounted as scheduled or indicated. Floor shall be level for proper installation.
- E. Lockers shall be installed on a 4 inch (102 mm) high base as scheduled or indicated. Base shall be level for proper installation.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 107300 – ALUMINUM CANTILEVER CANOPY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section furnishing and installation of extruded aluminum overhead cantilever canopy.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing".
 - 2. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, showing structural component locations/positions, material dimensions and details of construction and assembly.
- C. Delegated-Design Submittal: Sealed drawings and calculations for canopy design by professional engineer licensed to provide design services in Pennsylvania.
- D. Samples: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Certification from manufacturer that installing contractor is qualified and experienced in installation of cantilevered canopies.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair finish or replace canopies and/or component parts and materials that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cantilever canopy construction and connections. Engineering calculations are required and shall be signed and sealed by an engineer licensed within the state the canopy is to be installed.

- B. Structural Performance: Canopies shall comply with the structural requirements of the local building codes, UCC, & IBC 2018:

1. Design Loads: As determined by Delegated Design Engineer for project location and localized conditions.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUFACTURER

- A. Basis-of-Design Manufacturer: Mapes Canopies; 7748 North 56th Street, Lincoln, Nebraska.

1. Phone: 1-888-273-1132
2. Fax: 1-877-455-6572
3. www.mapes.com

- B. Alternate manufacturer and products: Subject to compliance with drawings and specifications, provide canopy by one of the following:

1. MASA Architectural Canopies, www.architecturalcanopies.com
2. Skyscape Canopies, www.skyscapecanopies.com

- C. Hanger Rod Canopy

1. Provide Basis-of-Design product; "Mapes Super Lumideck HR Canopy"

2.3 ALUMINUM CANOPIES

- A. Fabricate canopies as an integrated set of components ready for assembly on Project site.
- B. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.
- C. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Rear Gutter with leader provided by canopy manufacturer in color to be selected from manufacturer's standard range. Leader shall discharge to grade or adjacent rainwater leader in location acceptable to Civil Engineer and Authority Having Jurisdiction.
- D. Canopy Design and locations: As indicated on Drawings.
 - 1. Sizes: As indicated on Drawings.
- E. Materials:
 - 1. Decking shall consist of 3" extruded flat soffit .078 decking.
 - 2. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in manufacturer's standard profiles and thicknesses.
 - 3. Cantilever supported brackets shall be standard finish.
 - 4. Fascia shall be standard extruded 10" C-Channel style.
 - 5. Aluminum Sheet: ASTM B209 (ASTM B209M).
 - 6. Aluminum Extruded Shapes: ASTM B221 (ASTM B221M).
- A. Finishes:
 - 1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 2. Color and Gloss: As selected by Architect from manufacturer's full range of non-custom colors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install canopies according to manufacturer's written instructions.
- B. Installer shall confirm dimensions and elevations to be as shown on drawings provided by manufacturer.
- C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed
- D. Protect finishes of canopy components and adjacent construction during installation.

3.2 ADJUSTING

- A. After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION 105300

SECTION 107516 - 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 Submittals: 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 014000 "Quality Requirements," to design flagpole assemblies.
- B. Structural Performance: Flagpole assemblies, including anchorages and supports, to 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 115 mph

2.3 ALUMINUM FLAGPOLES

- A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. American Flagpole.
- b. Ewing Flagpole Co., Inc.; Ewing Group Company.
- c. US Flag & Flagpole Supply, LLC.

- B. Exposed Height: 25 feet (7.5 m).
- C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) 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.
- D. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

2.4 FITTINGS AND ACCESSORIES

- A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
 1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole or with gold anodic finish to be selected by Owner.
- B. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- (8-mm-) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
 1. Halyards and Cleats: Two at each flagpole.
 2. Halyard Flag Snaps: Stainless steel swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.
- C. Solar Disk Light: 1100 Lumen, 200 x 1W LED, mounted below finial ball. Provide finial ball stem extension.
 1. Color: White
 2. Warranty: 1 year.
 3. Lifespan: 40,000 hours.

2.5 MISCELLANEOUS MATERIALS

- A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
- B. Sand: ASTM C33/C33M, fine aggregate.
- C. Elastomeric Joint Sealant: Single-component neutral-curing silicone joint sealant complying with requirements in Section 079200 "Joint Sealants."
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 ALUMINUM FINISHES

- A. Clear or Color Anodic Finish: AAMA 611, AA-M12C22A41 or AA-M12C22A42/A44.
 - 1. Color: As selected by Architect from manufacturer's full range.

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. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.
- E. Place concrete, as specified in Section 033000 "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.
- F. 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 (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107516

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manually operated, single-roller shades.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Section 079200 "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.
 - 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.
- D. Samples for Initial Selection: For each type and color of shadeband material.
 - 1. Include Samples of accessories involving color selection.
- E. 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.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

1.6 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.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain roller shades from single source from single manufacturer.

2.2 Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1. MechoShade Systems, LLC.
- 2. Rollease Acmeda Inc.
- 3. Other manufacturers require approval by Architect prior to bidding.

2.3 MANUALLY OPERATED, SINGLE-ROLLER SHADES:

- A. 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: Manufacturer's standard.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.

- c. Chain-Retainer Type: Clip, jamb mount.
 - B. 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: Right side of interior face of shade unless field conditions dictate otherwise.
 - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
 - C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
 - D. Shadebands:
 - 1. Shadeband Material: Light-filtering fabric, antimicrobial, 3% openness.
 - 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.
 - E. 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 4 inches (102 mm).
 - 2. Endcap Covers: To cover exposed endcaps.
 - 3. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches (102 mm).
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
 - 4. Installation Accessories Color and Finish: As selected from manufacturer's full range.
- 2.4 SHADEBAND MATERIALS
- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
 - B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer.

2. Type: PVC-coated fiberglass or PVC-coated polyester, antimicrobial.
3. Weave: Mesh.
4. Orientation on Shadeband: Up the bolt.
5. Openness Factor: 3 percent.
6. Color: As selected by Architect from manufacturer's full range.

2.5 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 (23 deg C):
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible.

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 (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Electrical Connections: Connect motor-operated roller shades to building electrical system.
- C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123216 – CABINETS AND CASEWORK

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-clad architectural cabinets.
 - 2. Manufactured plastic-laminate-clad casework.
 - 3. Painted architectural cabinets.
 - 4. Cabinet Hardware and accessories.
 - 5. Plastic-laminate-faced wood paneling.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood blocking for anchoring casework.
 - 2. Section 055000 "Metal Fabrications" for support brackets.
 - 3. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
 - 4. Section 096513 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-clad casework.
 - 5. Section 123661.19 "Quartz Agglomerate Countertops."

1.3 DEFINITIONS

- A. Definitions in the AWI/AWMAC/WI's "Architectural Woodwork Standards" apply to the Work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 COORDINATION

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

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
 - 2. Indicate types and sizes of casework.
 - 3. Indicate manufacturer's catalog numbers for casework.
 - 4. Show fabrication details, including types and locations of hardware.
 - 5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.
- C. Samples for Verification:
 - 1. Plastic Laminate-clad Work:
 - a. High Pressure Laminate Panel: 8 by 10 inches for each color/pattern/surface finish.
 - b. Thermally-Fused Laminate Panel: 8 by 10 inches for each color/pattern/surface finish.
 - c. Edgebanding: 6 inch segment for each type and color used on edge of associated panel.
 - 2. Painted Work:
 - a. Panel product 12 inches wide by 12 inches wide for each finish system and color.
 - b. Corner Piece: Cabinet-front frame corner 12 inches wide by 12 inches wide.
 - 3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer/fabricator and Installer.
- B. Sample Warranty: For special warranty.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Fabricator Qualifications: Shop that employs skilled workers who fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- C. Manufacturer Qualifications: Employs skilled workers who fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

- D. Certifications: Licensed participant in AWI's Quality Certification Program or WI's Certified Compliance Program.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during remainder of construction period.
- B. Established Dimensions: Where the Work is indicated to fit to other construction, establish dimensions for areas where the Work is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Field Measurements: Where the Work is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.
- D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer/Fabricator/Installer agree to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 - d. Fading/chalking of painted finishes.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR ALL WORK

- A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards" for grades of casework, cabinets and panels indicated for construction, finishes, installation, and other requirements.
 - 1. Grade: Custom.

2. Provide labels and certificates from AWI/WI certification program indicating that the Work complies with requirements of grades specified.
3. Interior Design drawings indicate configurations, dimensions and finishes.

2.2 EXPOSED MATERIALS

1. Plastic-Laminate Grade: VGS.
 - a. Colors and Patterns: PL1
 - 1) Plastic Laminate 1, Option 1: Wilsonart, Hazel Walnut, 5788-NG
 - 2) Plastic Laminate 1, Option 2: Arborite, Sulawesi Hazel W462 EV
 - b. Colors and Patterns: PL2
 - 1) Plastic Laminate 2, Option 1: Wilsonart, Battleship 5014K-19
 - 2) Plastic Laminate 2, Option 2: Arborite, Brushed Pewter P325 MX
2. Painted Wood Cabinets: See specification 099123 "Interior Painting."
 - a. Colors - Vis: Painted Finish "P8" basis of design: SW6230, "Rainstorm."
 - b. Colors: Painted Finish "P9" basis of design: SW7514, "Foothills."

2.3 WOOD MATERIALS

1. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - a. Wood Moisture Content: 5 to 10 percent.
 - b. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than **3 inches (75 mm)** wide.
2. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - a. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
 - b. Softwood Plywood: DOC PS 1, medium-density overlay.
 - c. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.4 MATERIALS

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- C. Softwood Plywood: DOC PS 1.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
- F. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Manufacturers: Subject compliance with specifications and finishes schedules, provide products by one of the following:
 - a. Wilsonart LLC.
 - b. Laminart.
 2. Source Limitations: Obtain from single source from single manufacturer.
 3. **Plastic Laminate PLAM-1**
 - a. **Option 1 Wilsonart LLC, Color: Columbian Walnut, 7943**
 - b. **Option 2 Laminart, Color: Cabinetry Walnut, 992**
- G. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.
- H. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of ISO 4586.
1. Edgebanding for Thermally Fused Laminate (TFL) Panels: PVC or polyester edgebanding matching thermally fused laminate panels.

2.5 FABRICATION

- A. Plastic-Laminate-Clad Cabinet Construction: As required by referenced quality standard, but not less than the following:
1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard.
 2. Shelves: 3/4-inch- (19-mm-) thick plywood or 1-inch- (25-mm-) thick particleboard.
 3. Backs of Casework: 1/2-inch- (13-mm-) thick particleboard where exposed, 1/4-inch- (6.4-mm-) thick, veneer-core hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
 4. Drawer Fronts: 3/4-inch (19-mm) particleboard.
 5. Drawer Sides and Backs: 1/2-inch- (13-mm-) thick solid-wood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
 6. Drawer Bottoms: 1/4-inch- (6.4-mm-) thick hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (13-mm) material for drawers more than 24 inches (600 mm) wide.
 7. Cabinet Doors:
 - a. 48 Inches (1220 mm) High or Less: 3/4 inch (19 mm) thick, with particleboard or MDF cores.
 - b. 48 Inches (1220 mm) or More in Height: 1-1/8 inches (29 mm) thick, with particleboard cores.
- B. Filler Strips: Provide as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as casework.

2.6 PLASTIC-LAMINATE-CLAD CABINETS AND CASEWORK

- A. Manufacturers/Fabricators: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Advanced Cabinet Systems (ACS).
 2. Case Systems Inc.
 3. American Millwork & Cabinetry, Inc.
 4. Benchdogs, Inc.
 5. CommCab, Inc.
- B. Source Limitations: Obtain all plastic-laminate-clad Work from single source.
- C. Design: Frameless cabinet construction with the following door and drawer-front style:
1. Flush overlay.
 2. Edges: Grade VGS.
 3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- A. Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Thermally fused laminate panels.
 - a. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
 2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
 3. Drawer Bottoms: Thermally fused laminate panels.
- B. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
- C. Concealed Materials:
1. Solid Wood: With no defects affecting strength or utility.
 2. Plywood: Hardwood plywood.
 3. Plastic Laminate: Grade VGS.
 4. Particleboard.
 5. MDF.

2.7 PAINTED CABINETS AND CASEWORK

- A. Manufacturers/Fabricators: 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 Millwork & Cabinetry, Inc.
 2. Benchdogs, Inc.
 3. CommCab, Inc.

- B. Source Limitations: Obtain all painted Work from single source.
- C. Architectural Woodwork Standards Grade: Custom.
- D. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.
- E. Panel Product for Exposed Surfaces: Medium-density overlay.
- F. Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: Match materials indicated for exposed surfaces
- G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- H. Fabrication:
 - 1. Fabricate architectural cabinets to dimensions, profiles, and details indicated. Ease edges and corners to **1/16-inch (1.5-mm)** radius unless otherwise indicated.
 - 2. 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.
 - 3. 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.
- I. SHOP FINISHING
 - 1. Opaque Finish:
 - a. Finish: System - 4, water-based latex acrylic.
 - b. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D523.

2.8 HARDWARE AND ACCESSORIES

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
 - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, Type B01602, self-closing. Provide two hinges for doors less than 48 inches (1220 mm) high and provide three hinges for doors more than 48 inches (1220 mm) high.
 - 1. Degrees of Opening: 135 degrees.
 - 2. Manufacturer: Subject to compliance with project requirements, provide products by Blum, Inc.

- C. Pulls: Solid stainless steel bar pull, fastened from back with two screws.
 - 1. For sliding doors, provide recessed stainless steel or chrome-plated flush pulls.
 - 2. Provide two pulls for drawers more than 24 inches (600 mm) wide.
 - 3. Length: 5-3/8 inches, Centers at 3 inches.
 - 4. Diameter: 1/2-inch.
 - 5. Finish: Brushed stainless steel.
- D. Door Catches: Zinc-plated, dual, self-aligning, permanent magnet catch. Provide two catches on doors more than 48 inches (1220 mm) high.
- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
 - 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
 - 2. Drawers: Provide one bumper on back side of drawer front at each corner.
- F. Drawer Slides: ANSI/BHMA A156.9.
 - 1. Heavy Duty (Grade 1HD-100): Side mount.
 - a. Type: Full extension.
 - b. Material: Zinc-plated ball bearing slides.
 - c. Motion Feature: Self-closing mechanism.
 - 2. General-purpose drawers; provide 100 lb (45 kg) load capacity.
 - 3. File drawers; provide 150 lb (45 kg) load capacity.
 - 4. Manufacturer: Subject to compliance with project requirements, provide products by Blum, Inc.
- G. Drawer and Hinged-Door Locks: Brass with chrome-plated finish, and complying with ANSI/BHMA A156.11, Grade 1.
 - 1. Lock hardware shall accept Owner-provided SFIC interchangeable cores or be compatible with Owner master-keying system.
- H. Sliding-Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding-door unit.
- I. Adjustable Shelf Supports: Mortise-type, zinc-plated steel standards and shelf rests complying with ANSI/BHMA A156.9, Type B04071 and Type B04091.

2.9 PLASTIC-LAMINATE-FACED WOOD PANELING

- A. Manufacturers/Fabricators: 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 Millwork & Cabinetry, Inc.
 - 2. Benchdogs, Inc.
 - 3. CommCab, Inc.
- B. Source Limitations: Obtain all painted Work from single source.
- C. Grade: Custom.

D. Plastic Laminate: High-pressure decorative laminate complying with ISO4586-3.

1. Faces: Grade VGS.
2. Backs: Balance material with thickness matching exposed surface.
3. Exposed Edges: Same as faces.

E. Plastic Laminate PLAM-2

- a. Option 1 Wilsonart LLC, Color: Pearl Alloy, 5057
- b. Option 2 Laminart, Color: Pearlescence Shadow, 2451

F. Panel Core: Plywood.

1. Thickness: 3/4 inch (19 mm).

G. Exposed Panel Edges: Plastic-laminate matching faces.

H. Adhesives for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.

I. Assemble panels by gluing and concealed fastening.

2.10 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.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION – CASEWORK AND CABINETS

- A. Grade: Install Work to comply with same quality standard grade as item to be installed.
- B. Install Work level, plumb, and true in line; shim as required using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

- C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm). Bolt adjacent cabinets together with joints flush, tight, and uniform.
- D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).
- E. Fasten cabinets to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards."
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- G. Adjust operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION - PANELS

- A. Before installation, condition paneling to humidity conditions in installation areas.
- B. Grade: Install paneling to comply with quality standard grade of paneling to be installed.
- C. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.
- D. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless otherwise indicated.

3.4 CLEANING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123216

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.
4. Quartz agglomerate apron fronts.
5. Countertop support brackets.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for under-counter brackets.
2. Section 085653 "Security Windows" for recessed door trays.
3. Section 090600 "Finishes Schedule" for color selections for each product.
4. Section 123216 "Cabinets and Casework" for undercounter cabinets and laminate panels.
5. Section 221000 "Plumbing Fixtures" for sinks and plumbing fittings.

1.2 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.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches (150 mm) square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 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.

1.5 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.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 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 polymers, resins, and pigment and complying with ISFA 3-01.
- B. Products: Subject to compliance with the requirements of this section, provide one of the following:
 - 1. Quartz Surface QTZ-1, Option 1: Wilsonart, LLC: Quartz, Q4065 "Fossa Falls,"
 - 2. Quartz Surface QTZ-1, Option 2: Cambria USA, Quartz, Signature Series, "Swanbridge.
 - 3. Finish: Matte/Honed
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP SUPPORT BRACKETS

- A. Countertop Support Brackets: Pre-fabricated metal brackets for the support of countertops and associated paneling.
- B. Bracket Types:
 - 1. Surface-mounted: Where noted on drawings.
 - 2. Concealed, stud-mounted brackets. Where noted on drawings.
 - 3. ADA-compliant with fascia panel supports: Kitchen sinks, Counter-mounted lavatories.
- C. Manufacturers: Subject to compliance with the requirements of this section, provide products by one of the following:

1. A&M Hardware, Inc.; 1165 Strickler Rd., Mount Joy, PA 17552; (888) 647-0200; www.aandmhardware.com.
 2. Rakks Architectural Shelving and Hardware; 254 Turnpike Road, Westborough, MA 01581; (781) 455-8700 x2; www.rakks.com.
 3. Federal Brace; 710 E Catawba St, Suite A, Belmont, North Carolina, 28012; www.federalbrace.com.
- D. Size: Bracket size to be per manufacturer's recommendation for supported countertop dimensions.
- E. Spacing: Space brackets no further than
- F. Color: As selected by Architect from manufacturer's available non-custom colors.

2.3 FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
1. Grade: Custom.
- B. Configuration: Countertops on base cabinets
1. Front: 1-1/2-inch (38-mm) laminated bullnose.
 2. Backsplash: Straight, slightly eased at corner.
 3. End Splash: Matching backsplash.
- C. Configuration: Worktops on wall brackets
1. Front and side edges: 1-1/2-inch (38-mm) laminated bullnose.
 2. Backsplash: None.
 3. End Splash: None.
- D. Configuration: Toilet Room Vanity Tops
1. Front: Straight, slightly eased at top with separate apron, 6 inches (150 mm) nominal height.
 - a. Coordinate apron height with under-counter bracket fascia mount height so that quartz fascia extends below bottom edge 1/2 inch minimum.
 2. Backsplash: Straight, slightly eased at corner.
 3. End Splash: Matching backsplash.
- E. Countertops: 3/4-inch- (19-mm-) thick, quartz agglomerate with front edge built up with same material.
- F. Backsplashes: 3/4-inch- (19-mm-) thick, quartz agglomerate.
- G. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

H. Joints:

1. Fabricate countertops without joints.
2. Countertops on base cabinets: Fabricate countertops MAY be fabricated in sections for joining in field.
 - a. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 10 feet (305 cm) long would result, unless unavoidable.
 - b. Joint Type, Bonded: 1/32 inch (0.8 mm) or less in width.

I. 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 (5 mm) into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch (10-mm) radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch (5 mm) into fixture opening.
 - c. Provide 3/4-inch (20-mm) full bullnose edges projecting 3/8 inch (10 mm) 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.
4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
5. Recessed Dish Trays: Prepare countertops in shop for field cutting opening for recessed dish tray. Mark tops for cutouts coordinated with specified product and drill holes at corners for cutout locations. Make corner holes of largest radius practical.

2.4 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "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 (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) 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. 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 quartz agglomerate manufacturer's written instructions. 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.
- 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 079200 "Joint Sealants."

END OF SECTION 123661.19

SECTION 210501

BASIC FIRE PROTECTION REQUIREMENTS

PART 1 - GENERAL

- 1.1 Applicable requirements of the Contract Documents, preceding the technical Specifications, apply to this Section. In the event of conflict between the Specifications, the most stringent shall apply.
- 1.2 Separations of these Specifications into divisions and sections is for convenience only and is not intended to establish limits of work.
- 1.3 Consult index to be certain that set of documents and Specifications is complete. Report omissions or discrepancies to the Owner's Representative.
- 1.4 The Contractor shall employ high standards of good workmanship and shall pay special attention to the safety of the equipment. The installation of material and equipment shall be in conformance with the codes and standards listed in Paragraph: STANDARDS. The agency having the most stringent requirements shall be adhered to.
- 1.5 The Contractor shall make a thorough examination of the site and shall make due allowances for difficulties and contingencies to be encountered. All dimensions shall be checked and verified by the Contractor at the site.
- 1.6 The Contractor and all Sub-Contractors shall have a minimum of three years proven experience on projects with similar levels of complexity and magnitude. Experience shall be based on the experience as a company and not on the experience as individuals.
- 1.7 The Drawings and Specifications are intended to function as a common set of documents. Anything shown on the Drawings but not mentioned in the Specifications or mentioned in the Specifications and not shown on the Drawings, shall be equally binding as if both noted on the Drawings and called for in the Specifications.
- 1.8 SCOPE
 - A. The work covered by and included in these Specifications consists of the furnishing of all materials, all equipment, labor, tools and supervision and performing all operations necessary for the proper and complete execution of the Fire Protection work in strict accordance with the Specifications and the Drawings and subject to the terms and conditions of the Contract:
 - B. The sprinkler system shall be designed and installed by a recognized Fire Protection Contractor who is an experienced specialist in design and construction of automatic sprinkler systems. The sprinkler system shall be hydraulically designed. The Contractor shall submit to the Owner or the Owner's Representative evidence in writing of comparable experience prior to beginning the project.

- C. Prior to installation, the Fire Protection Contractor shall prepare Design Drawings of the automatic sprinkler system at a scale of not less than 1/8 inch = 1foot 0 inches and submit them to the Fire Marshal and the Owner's insurance company for approval. The Drawings shall be sealed by a Professional Engineer registered in the State of Pennsylvania. After approval, the Drawings shall be submitted to the Owner's Representative for approval. No work shall be done on the system and no materials shall be ordered until the Drawings have been reviewed and approved.
- D. Contractor shall obtain accurate, up-to-date pressure and flow readings from the local Water Authority or the local Fire Marshal. If pressure and flow readings are outdated or not available, the Contractor shall perform a flow test or make appropriate arrangements with the local authority to have one performed at or near the project site.
- E. Upon completion of the installation the systems shall be hydrostatically tested and flushed as specified in NFPA 13, IN THE PRESENCE OF THE OWNER OR THE OWNER'S REPRESENTATIVE. The Contractor shall submit a signed and dated certificate to the Owner or the Owner's Representative as stipulated in NFPA 13.
- F. Provide, as a part of this work, two inspections by sprinkler installer during first operational year. Submit inspection reports in triplicate, to the Owner or the Owner's Representative within 15 days from date of inspection.

1.9 DEFINITIONS

- A. The term "Contractor" or "Fire Protection Contractor" when used in this Specification refers to the Contractor responsible for all work under this Section.
- B. The term "Provide" refers to this Contractor purchasing, delivering and installing as a part of this Contract.
- C. The term "ATC" refers to Automatic Temperature Controls.

1.10 STANDARDS

- A. Meet requirements and recommendations of applicable portions of the latest edition of all codes and standards, as adopted by the local authority having jurisdiction, including those listed:
 - 1. American Society of Mechanical Engineers (ASME).
 - 2. American Society for Testing and Materials (ASTM).
 - 3. National Fire Protection Association (NFPA 13, 14, 20).
 - 4. Underwriter's Laboratories (UL).
 - 5. American National Standards Institute (ANSI).
 - 6. International Building Code.
 - 7. International Fire Code.
 - 8. American Welding Society Standards (AWS).
 - a. 2018 International Building Code (IBC).
 - b. 2018 International Fire Code (IFC).
 - c. Latest Edition of Philadelphia Fire Protection Code.
 - d. Regulations of the Pennsylvania State Police, Fire Marshall Division.
 - 9. Occupational Safety and Health Administration (OSHA).
 - 10. Public Law 101-336, The Americans with Disabilities Act of 1990.

- B. Should any change in the Drawings and/or Specifications be required to conform to the codes, ordinances, regulations or laws mentioned above, the Owner's Representative shall be notified prior to the time of submitting bids.

1.11 NOTIFICATION

- A. Trades that have work connected with the Fire Protection work and trades that do preparatory work for Fire Protection shall be notified for installation requirements and scheduling.
- B. The Owner's Representative shall be informed of the installation schedule to allow sufficient time for inspection without any work delay.
- C. All work shall be coordinated to avoid cutting of work in place and interfering with other operations.
- D. In compliance with Act 38, contact individual companies to have utility locations marked in the field and to otherwise locate underground objects as may be necessary prior to the start of construction.
 - 1. Pennsylvania law requires three working days notice for the construction phase and ten working days in design stage. Call Delaware One Call 1-800-282-8555, as of this writing.

1.12 CONTRACT DRAWINGS

- A. Contract Drawings are diagrammatic and indicate the relation of piping, ductwork, connections and equipment. The Drawings do not indicate all offsets, elbows and fittings that may be required. Therefore, the Contractor shall carefully investigate the structural and finish conditions affecting the work. The Contractor shall furnish all offsets, elbows, fittings, hangers and accessories as may be required to meet these conditions at no additional cost to the Owner.
- B. The contractor shall coordinate his work with that of other trades. The Contractor shall prepare dimensioned arrangement drawings at a scale of (1/4" = 1'0"). Layouts represented by these drawings shall be coordinated with all other trades. Where physical interferences with his work occur because of his failure to consult other trades, the Contractor shall rearrange his work at his own expense.
- C. Do not scale the Drawings. The Contractor shall check conditions at the site for dimensions and sizes pertaining to the structure.
- D. Do not deviate from the Drawings without prior approval.

1.13 LINES, GRADES AND SUVEYS

- A. All necessary surveys, lines, grades and measurements are the responsibility of the Contractor desiring the information for the proper installation of his work. The Contractor is responsible for the proper installation of the work with respect to other Contractors.
- B. Grades, elevations and locations shown on the Drawing are approximate and the Contractor shall check all such information on the site before proceeding with the work.

1.14 WORKMANSHIP

- A. All equipment, piping, conduit, insulation, fixtures, etc. shall be installed meeting the accepted standards of the representative industry.
- B. All work to be performed shall be done by qualified mechanics. All mechanics in the employ of this Contractor on this project shall be skilled in the phases of the work to which they are used. The mechanic's affiliation with labor organizations shall be acceptable to all trades employed on the project.

1.15 SUBMITTAL PROCEDURES

- A. Transmit each submittal with an Owner's Representative accepted form. Include one copy each for the Owner and the Owner's Representative in addition to copies required by Contractor.
- B. Sequentially number the transmittal forms. Resubmittals shall have original number with an alphabetic suffix.
- C. Identify Project, Contractor, Sub-Contractor or Supplier; pertinent drawing sheet and detail number and specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- E. Incomplete submittals shall not relieve the Contractor of providing a complete and functional system.
- F. Schedule submittals to expedite the Project. Coordinate submission of related items.
- G. Submittals by the Contractor must be in complete compliance with the Contract Documents unless exceptions are identified. Exceptions to the Contract Documents may only be made to improve the project. Exceptions cannot be taken which would provide an incomplete and/or nonfunctional system.
- H. Exceptions must be included in/on the submittal in a separate paragraph or drawing block located below the Contractor's stamp identified by the title "Exception to Contract Documents." Exceptions cannot be part of the standard Contractor's stamp.
- I. Provide space for Contractor and Owner's Representative review stamps.
- J. The Owner's Representative will return shop drawings with the following designations.
 - 1. Approved: Further submission not required.
 - 2. Approved as Noted: Corrections must be incorporated in final installation. Further submission not required unless specifically noted.
 - 3. Noted: Placed in project files for information only.
 - 4. Revise and Resubmit: Make necessary changes and resubmit prior to fabrication.
 - 5. Not Approved: Does not meet project requirements. Resubmit in accordance with Contract Documents.
- K. Revise and resubmit submittals as required, identify all changes made since previous submittal.

- L. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.16 SHOP DRAWINGS/PRODUCT DATA

- A. Submit shop drawings and/or catalog cuts for all specified equipment:
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.
- D. Show sizes and locations, by dimensioning, of piping, fittings, hose cabinets, sprinkler heads, equipment and other sprinkler items. Identify materials and equipment by description and number.
- E. Include wiring diagrams, hole location and sizes and other data that could affect work by other trades.
- F. Show manufacturer's names, trade names, catalog numbers, accessories, special features and rating data.
- G. Indicate required clearances for operating parts, for removal and for servicing.
- H. Show performance data, including pump curves.
- I. Show sound power levels of all rotating equipment.

1.17 SUBSTITUTIONS

- A. Any bidder wishing to substitute "or equal" equipment may request a substitution. Manufacturers which are submitted as substitutions for approved equal status are considered to have equipment of similar quality; however, the Contractor shall not assume that a piece of equipment by a manufacturer submitted as a "substitution" will be automatically accepted. Compliance with the Drawings and Specifications is still required. If the substituted material is considered to be unacceptable, the Contractor shall provide the equipment as originally specified.
- B. Substitutions are encouraged when there is a significant cost savings or an improvement to the project. Submit reasons for changes with any requests for substitution.
- C. Bid alternates shall be clearly defined on the bid forms in order to be evaluated during the bidding process.
- D. By submitting an alternate or substitution, the Contractor automatically agrees to the following.
- E. The Owner shall be reimbursed by the Contractor for any additional costs incurred by the Owner's Representative to review the substituted materials, in accordance with the then current Owner's Representative's hourly rate.
- F. The Owner shall be reimbursed by the Contractor for any additional costs incurred by the Owner's Representative for field or office conferences caused by the substituted materials shall be paid by the Contractor in accordance with the then current Owner's Representative's hourly rate.

- G. The consideration of alternates/substitutions does not obligate the Owner's Representative to accept same.
- H. In the event a brand is approved and substituted, it is the responsibility of the Contractor to so coordinate his substituted material into the original work at no extra cost to the Owner or any other Contractor.

1.18 CUTTING AND PATCHING

- A. In new construction, the Contractor shall give the General Contractor complete information as to size of openings required in floors and walls, etc., so that such openings may be provided as the project progresses. In existing construction, the Contractor shall do his own cutting and patching required for the installation of his work.
- B. If openings are omitted or are incorrect through failure of the Contractor to follow these instructions, the Contractor shall, at his own expense, engage the trade which originally installed the work, to cut and patch to the satisfaction of the Owner's Representative.
- C. All cutting and patching of every nature required in connection with this Contract shall be done by the Contractor with mechanics experienced in their respective lines of work. All patching shall match adjacent finishes.
- D. All cutting in the building shall be done with great care so as not to leave an unsightly surface, which may not be concealed by plates, escutcheons or other normal concealing construction. If such unsightly conditions occur, the Contractor shall be required at his own expense, to engage the General Contractor to replace the damaged materials with new materials.

1.19 CONCRETE AND MASONRY WORK

- A. Unless otherwise noted, all concrete bases, reinforcing, etc. and masonry work required to install the respective Contract Work shall be furnished and installed by the respective Contractor.
- B. The Contractor shall furnish all materials, labor, equipment and tools necessary to complete concrete work.
- C. All concrete work shall comply with the requirements of the ACI Building Code (ACI 318), the ACI Detailing Manual (ACI 315) and the Specifications for Structural Concrete for Buildings (ACI 301).
- D. All reinforcing steel shall be manufactured from high strength billet steel conforming to ASTM Designation A-615, Grade 60. WWF shall comply with ASTM A-185.

1.20 MATERIALS

- A. All materials and equipment provided by this Contractor shall be new, without imperfections and blemishes and shall be protected from the elements prior to installation in the building.
- B. All equipment shall be tested, listed and labeled by an approved authority (UL, AGA, ETL) and shall be installed in accordance with its listing.
- C. All equipment subject to specific requirements of the Owner's insurance company (gas trains, etc.) shall meet the insurance companies requirements.

1.21 METHODS

- A. The Fire Protection Contractor shall confer with all other Contractors and shall apply for detailed and specific information regarding the location of all equipment as the final location may differ from that indicated on the Drawings. Piping or equipment improperly placed because of the Fire Protection Contractor's failure to obtain this information shall be relocated and reinstalled by the Fire Protection Contractor without additional expense to the Owner.
- B. Each Contractor, upon request of the Owner's Representative, shall expedite the work of a specific area, section or part of the project to permit the installation of another part of the work.
- C. All piping, accessories and equipment shall be installed in such a manner as to preserve access with sufficient space provided for proper operation and maintenance to any existing equipment or to any new equipment installed under this Specification or under other Specifications or Contracts for this building.
- D. This Contractor shall coordinate his work with that of other trades so that all work may be installed in the most direct manner and so that interference between piping, ducts, equipment, architectural or structural features will be avoided. In the case interference results, the Owner's Representative shall decide which work is to be relocated, regardless of which is first installed. Such relocation shall be at no additional cost to the Owner.
- E. All materials and equipment installed by the Contractor shall be firmly supported and secured to the building structure where required.
- F. All items of labor, material and equipment not specified in detail or shown on the Drawings but incidental to, or necessary for, the complete and proper installation and proper operation of the work described herein or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Specifications or Drawings.
- G. The Contractor shall provide isolation valves and unions or flanges at all pieces of equipment and at all branch take-offs serving five or more pieces of equipment to facilitate replacement or service of the equipment.
- H. All equipment shall be installed in accordance with the manufacturer's recommendations and installation instructions. The manufacturer's installation instructions shall be considered part of this Contract.

1.22 SCHEDULING OF WORK

- A. The Contractor shall attend all planning meetings, provide scheduling information and work with all trades to obtain a workable project schedule that meets the Owner's requirements:

1.23 PROTECTION

- A. Each Contractor shall effectively protect his work and materials with tarpaulins or heavy plastic material against dirt, water, chemicals, plaster or damage during the entire period of installation or until he is directed to remove the coverings by the Owner's Representative. Any damaged material must be removed and replaced by the Contractor without additional cost regardless of the cause of the damage. All openings in pipes, fittings, etc., must be effectively sealed to exclude dirt, sand and other foreign substances.

1.24 PROTECTION OF OWNER'S EQUIPMENT

- A. The Contractor shall provide any temporary work required to protect the Owner's equipment and to contain the dust generated during construction. Any measures taken by the Contractor for the protection of equipment shall be installed to the satisfaction of the Owner or the Owner's Representative, which may include any and all provisions listed in DIVISION-1 General Requirements and/or in accordance with the appropriate technical specifications for wood and plastics in DIVISION-6. An approved protection material is nylon reinforced flame retardant and anti-static Griffolyn T-75 ASFR 8 mil film.

1.25 RUBBISH REMOVAL AND CLEAN-UP

- A. Each Contractor is responsible for periodic removal of all rubbish resulting from his work. All surplus material, refuse, rubbish, etc., shall be removed from the job site at completion of Contract. The Owner's Representative must be satisfied with the removal and clean-up.

1.26 DELIVERING AND STORAGE OF MATERIALS AND EQUIPMENT

- A. Deliver accessories, small, unmarked parts, adhesives and incidental items to site in manufacturer's original, unopened, labeled containers.
- B. Store materials and equipment to prevent damage and injury. Store ferrous materials to prevent rusting. Store equipment to prevent staining and discoloring.

1.27 AS-BUILT DRAWINGS

- A. During construction, the Contractor shall maintain a record set of installation prints. He shall record on these prints, all deviations from the Contract Drawings in pipe sizing, duct sizing, location and details.
- B. At the completion of the work, the Contractor shall transfer this information neatly onto three sets of prints and forward these prints and the as-built prints to the Owner's Representative.
- C. [At the completion of the work, the Contractor shall transfer this information onto one set of prints and onto computer generated construction documents and forward the as-built prints and an electronic copy to the Owner's Representative. Electronic copies of the Fire Protection drawings, without title blocks, will be made available to the Contractor in AutoCAD versions 2000 or 2002.]

1.28 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Prior to completion of this project, the Contractor shall deliver to the Owner's Representative for approval three copies of an Operating and Maintenance Manual consisting of items outlined hereinafter.
- B. The purpose of this manual is to assist the Owner in routine operation, maintenance, servicing, troubleshooting and procurement of replacement parts. All information in the manual shall be as-built and only material pertinent to the project shall be included.
- C. The manual shall include the following.

- D. Manuals shall be bound, 8-1/2 x 11 inch text pages and set in three-ring binders with durable covers.
 - E. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of project and subject matter of binder when multiple binders are required. All subject matter shall be in typewritten format.
 - F. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab labeling clearly printed under reinforced laminated plastic tabs.
 - G. Contents: Prepare a Table of Contents for each volume with product or system description identified, type on white paper.
 - H. Part 1: Directory, listing names, addresses and telephone numbers of Owner's Representative, Contractor, Sub-Contractors and major equipment suppliers.
 - I. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses and telephone numbers of Sub-Contractors and suppliers. Operating and start-up instructions shall be written in a concise step-by-step manner. Maintenance instructions shall include maintenance schedules, procedures, adjustments and trouble-shooting techniques. All non-pertinent information in the manuals shall be either eliminated or crossed out in a neat and thorough manner. Identify the following.
 - 1. List of equipment.
 - 2. Parts list for each component.
 - 3. Operating instructions.
 - 4. Maintenance instructions for equipment and systems.
 - J. Part 3: Project Documents and certificates, including the following.
 - 1. Corrected shop drawings and product data.
 - 2. Control wiring diagrams.
 - 3. Certificates.
 - 4. Photocopies of warranties.
 - 5. Valve tag list.
 - K. Submit one copy of completed volumes in final form 30 days prior to final inspection. This copy will be returned after final inspection, with the Owner's Representative's comments. Revise content of documents as required prior to final submittal.
 - L. Submit final volumes revised, within ten days after Owner's review.
- 1.29 IDENTIFICATION OF MATERIALS AND EQUIPMENT
- A. Label concealed and exposed piping not more than 25 feet on centers and adjacent to all valves and equipment for easy identification. This does not apply to control compressed air, underground pipe or pipe located within walls. Show flow arrows and medium conveyed in the pipe. Labels shall conform to ANSI A13.1 for color, letter size and marker length.
 - B. Identify starters, fans, air conditioning units and other equipment with permanent plates giving name of item, manufacturer's name and operating characteristics.

- C. Show, for items with moving parts, complete information regarding lubricating materials and frequency of lubrication.
- D. Valve tags shall be provided on all valves. Tags shall be two inches in diameter, brass, Style 300-BL as manufactured by Seton Name Plate Corporation. Each tag shall be securely fastened to the valve stem with brass "S" hooks. Additional tags shall be fastened on ceiling tiles or access doors to further identify concealed valves.
- E. Each tag shall be stamped showing the system name, valve identification number, function and position (i.e., N.O., N.C., Balancing Two-Way, Modulating, etc).
- F. The Contractor shall provide a typewritten valve list segregated by systems, showing valve number, equipment served or system function and location in building by room and nearest column. The list should be on 8-1/2 x 11 inch paper bound in plastic binder and three copies submitted to the Owner or the Owner's Representative for approval and after approval, six copies for final information.

1.30 PAINTING

- A. Where factory finishes are provided and no additional field painting is specified; all marred or damaged surfaces shall be touched up or refinished to a smooth and uniform finish.
- B. All exposed ferrous metalwork, pipe, supports, hangers, insulation and other surfaces not factory painted shall be painted with one prime and two finish coats. Paint, surface preparation and application shall be as specified in Section: PAINTING. Colors shall match existing work or shall be as selected by the Owner's Representative.

1.31 LAWS, ORDINANCES AND REGULATIONS.

- A. All systems in all and/or part shall conform to all pertinent laws, ordinances and regulations of ALL bodies having jurisdiction, at all governing levels. In case of conflict between governing levels, the more stringent law shall apply. As a minimum, all work shall comply with BOCA, NFPA, OSHA and Pennsylvania Labor and Industry requirements.
- B. The Contractor shall pay all fees, prepare and submit all utility applications and obtain and pay for all permits and inspections required for his work, including L&I pressure vessel installation plans, inspections and approvals.

1.32 BUILDING EXPANSION JOINTS AND FIRE RATED ASSEMBLIES.

- A. Provide expansion joints in piping where they cross building expansion joints.
- B. Meet all requirements of Underwriter's Laboratories and all applicable codes for maintaining the integrity of all fire rated assemblies.

1.33 ACCESS DOORS.

- A. The Contractor shall provide access panels/access doors for access to valves, balancing valves or cocks, water hammer arrestors, cleanouts or any other equipment or component requiring access for maintenance, adjustment or service wherever these items are concealed in building walls, partitions or ceilings. Frames shall be anchored in walls, partitions or ceilings and shall be

set true to lines of the building and flush with the finished surfaces. Access panels/access doors shall be as specified in the General Construction Sections of the Specifications.

1.34 FASTENING, SUPPORTS AND HANGERS.

- A. All fastenings, supports, hangers, miscellaneous steel, clamps and anchors shall be type made for specific purpose to be used; toggle bolts or machine bolt fastenings shall be used for hollow tile, terra cotta or lath construction; machine screws shall be used for structural steel fastenings; lead expansion shield and machine screws or lag screws shall be used for solid masonry fastening; lag screws shall be used for wood fastening; all equipment and piping shall be rigidly and firmly installed to prevent swaying, vibrating or sagging by malleable or wrought steel hangers of standard design, pipe clamps or fabricated steel supports of approved design; hangers of horizontal piping runs shall be adjustable clevis type; perforated strap iron hangers and caddy clips are not permissible.

1.35 SOUND PARTITIONS.

- A. Contractor shall be responsible to identify all sound partitions indicated on the architectural plans. Contractor shall seal all penetrations through the wall to maintain the sound absorption integrity of the partition.

1.36 CONCRETE INSERTS.

- A. The Fire Protection Contractor shall provide and install concrete inserts of an approved carbon steel wedge-type for all hangers. Where two or more parallel pipes are installed continuous inserts may be used. Where required to distribute the load on the inserts, a piece of reinforcing steel of sufficient length shall be passed through the insert. Each insert shall include a knockout piece. Inserts shall have a minimum safety factor of five.

1.37 SLEEVES.

- A. The Fire Protection Contractor shall provide and install sleeves where required to protect equipment or facilities in the installation. Each sleeve shall extend through its respective floor, wall, or partition and shall be cut flush with each surface unless otherwise required.
- B. Sleeves in bearing and masonry walls, floors and partitions shall be of standard weight steel pipe finished with smooth edges. For other masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 U.S.G. galvanized iron.
- C. All sleeves shall be properly installed and securely cemented in place.
- D. Floor sleeves shall extend one inch above the finished floor. Space between floor sleeves and passing conduit shall be caulked with an approved graphite packing or waterproof caulking compound.
- E. Where pipes pass through waterproofed floors or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
- F. Where piping or conduits pass through fire resisting portions of the structure, the annular space between the sleeve and the pipe or conduit shall be filled with an approved fireproof material as required to maintain the fire rating of that portion of the structure. "Firestop Penetrator", or

"Proseal Plug Devices" as manufactured by ProSet Systems (or approved equal) shall be used for piping and conduit.

- G. See architectural drawings for fire ratings of building components.

1.38 FIRE STOPPING.

- A. The contractor shall be responsible to provide and install fire-stopping materials and/or systems where his work penetrates fire and/or smoke rated portions of the building and non-fire resistance-rated assemblies. All materials used shall be manufactured such that they are intended to resist the spread of fire and the passage of smoke. This includes but is not limited to rated walls, floors, shafts, ceilings, and non-fire resistance-rated horizontal assemblies. All fire stopping materials used shall have a fire resistance rating equal to or greater than the rated assembly for which they are installed.
- B. For locations where the installed fire stopping material is exposed to normal view, the contractor shall conceal the material with chrome-plated escutcheon plates or other materials that have a flame-spread value of 25 or less and a smoke developed rating of 50 or less, as determined per ASTM E 84. The concealing device shall be approved by the owner's representative prior to installation. Provide shop drawings for each device.
- C. The contractor shall provide components/accessories for each fire-stopping system that are needed to install fill materials and to comply with all system performance requirements as recommended by the fire stopping material manufacturer. Accessories include but are not limited to: mineral wool insulation, ceramic fiber, sealants used to aid in the formation of the fire stopping materials, fire-rated formboard, joint fillers and sealers, collars and steel sleeves.
- D. Fire stopping materials and systems shall include, but are not limited to, the following: fire barrier caulk and sealants, intumescent caulk, intumescent putty, intumescent wrap strips, silicone foams and sealants, fire barrier composite sheets and cast-in-place fire barrier systems
- E. Fire stopping materials and systems shall be as manufactured by 3M Fire Protection Products, Hilti Corporation, or ProSet Systems Inc.

1.39 ANCHOR BOLTS.

- A. The Contractor shall provide and set in place, at the time of pouring of concrete foundations, all necessary anchor bolts as required for the equipment called for in these Specifications. Anchor bolts shall be of the hook type, of proper size and length to suit the equipment. Anchor bolts shall be set in pipe sleeves of approximately twice the bolt diameter and one half the embedded length of the bolt. The Contractor shall assume full responsibility for proper coordination and placement of the bolts. Upon completion of equipment installation, pipe sleeves shall be caulked in accordance with Paragraph, "Sleeves," in this Section of the Specifications.

1.40 WARRANTY.

- A. The systems specified herein shall be guaranteed to be free from defects in workmanship and material under normal use and service for a period of one year (five years for all compressors) from date of substantial completion.
- B. If, within the aforementioned warranty period, any of the materials specified herein is proven to be defective in any way, it shall be replaced or repaired at no additional cost to the Owner. The

warranty shall include the providing of all labor and materials necessary for repair or replacement of any defective components. The Contractor is responsible for the costs of any services required by equipment suppliers that are not included in the suppliers' warranties.

- C. The Contractor shall, after acceptance of the installation by the Owner or the Owner's Representative, provide any service incidental to the proper performance of the systems under the warranties outlined above for the time periods listed above.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 210501

SECTION 210517

SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.
 - 6. Silicone sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule-40, with plain ends and welded steel collar, zinc coated.
- C. Galvanized Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- 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. Smith, Jay R. Mfg. Co
- B. Zurn Specification Drainage Operation; Zurn Plumbing Group. Description: Manufactured, cast iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- 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. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- 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. Pre-sealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants".
- E. Fire-Barrier Penetrations, Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Use grout to seal around the outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Use grout, to seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Concrete Slabs-above-Grade:
 - a. Piping Smaller Than NPS 6: Galvanized Steel pipe sleeves.
 2. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized steel pipe sleeves.

END OF SECTION 210517

SECTION 210518
ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With white finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with white finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With white finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With white finish; concealed hinge and setscrew

2.2 FLOOR PLATES

- A. One Piece Floor Plates: Cast-iron flange with hoes for fasteners.
- B. Split Casting Floor Plates: Chrome plated brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping.
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Painted Piping: One-piece cast-brass type with white painted finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast-brass or split-casting brass type with white finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass or split-casting brass type with white finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece cast-brass or split-casting brass type with white finish.
 - f. Bare Piping in Equipment Rooms: One-piece cast-brass type with white finish.
 - 2. Escutcheons for Existing Piping to Remain:
 - a. Chrome-Plated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor plate.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

SECTION 210523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Two-piece ball valves with indicators.
 - 2. Bronze butterfly valves with indicators.
 - 3. Iron butterfly valves with indicators.
 - 4. Check valves.
 - 5. Bronze OS&Y gate valves.
 - 6. Iron OS&Y gate valves.
 - 7. NRS gate valves.
 - 8. Trim and drain valves.

1.3 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:

1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
1. Main Level: HAMV - Fire Main Equipment
 - a. Level 1: HCBZ - Indicator Posts, Gate Valve.
 - b. Level 1: HLOT - Valves
 - c. Level 3: HLUG - Ball Valves, System Control.
 - d. Level 3 Valves: HLXS - Butterfly Valves
 - e. Level 3: HMER - Check Valves
 - f. Level 3: HMRZ - Gate Valves
 2. Main Level: VDGT - Sprinkler System & Water Spray System Devices
 - a. Level 1: VQGU - Valves, Trim and Drain
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves.
 - 1) Gate valves.
 - 2) Check valves
 - a) Single check valves
 - 3) Miscellaneous valves.
- C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- D. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
 2. ASME B16.1 for flanges on iron valves.
 3. ASME B31.9 for building services piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- F. NFPA Compliance for valves: Comply with NFPA 24 for valves

- G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

- 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. NIBCO INC
 - 2. Victaulic Company
- B. Description:
 - 1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body Design: Two piece.
 - 4. Body Material: Forged brass or bronze.
 - 5. Port Size: Full or standard.
 - 6. Seats: PTFE.
 - 7. Stem: Bronze or stainless steel.
 - 8. Ball: Chrome-plated brass.
 - 9. Actuator: Worm gear
 - 10. Supervisory Switch: Internal or external.
 - 11. End Connections for Valves NPS 1 through NPS 2 : Threaded ends.
 - 12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

- 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. Fivalco Inc.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Milwaukee Valve Company.
- B. Description:
 - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
 - 2. Minimum: Pressure rating: 175 psig .
 - 3. Body Material: Bronze.
 - 4. Seat Material: EPDM.
 - 5. Stem Material: Bronze or stainless steel.

6. Disc: Bronze with EPDM coating.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

- 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. Anvil International, Inc.
2. Fivalco Inc.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve; a division of McWane, Inc.
5. NIBCO INC
6. Tyco Fire & Building Products LP.
7. Victaulic Company

- B. Description

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved end connections

2.5 CHECK VALVES

- 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. Anvil International, Inc.
2. Fire Protection Products, Inc.
3. Fivalco Inc.
4. Globe Fire Sprinkler Corporation.
5. Kennedy Valve; a division of McWane, Inc.
6. Matco Norca.
7. Mueller Co.; Water Products Division.
8. NIBCO INC.
9. Reliable Automatic Sprinkler Co., Inc.
10. Shurjoint Piping Products.
11. Tyco Fire & Building Products LP.
12. United Brass Works, Inc.
13. Venus Fire Protection Ltd.
14. Victaulic Company
15. Viking Corporation
16. Watts Water Technologies, Inc.

17. Wilson & Cousins, Inc.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

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. Milwaukee Valve Company.
2. NIBCO INC
3. United Brass Works, Inc..

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External
9. End Connections: Threaded

2.7 IRON OS&Y GATE VALVES

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 Cast Iron Pipe Company; Waterous Company subsidiary
2. Clow Valve Company; a division of McWane, Inc.
3. Hammond Valve
4. Kennedy Valve; a division of McWane, Inc
5. Mueller Co.; Water Products Division
6. NIBCO INC>
7. Victaulic Company
8. Watts Water Technologies, Inc.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.8 NRS GATE VALVES

- 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 Cast Iron Pipe Company; Waterous Company subsidiary
2. Clow Valve Company; a division of McWane, Inc.
3. Kennedy Valve; a division of McWane, Inc
4. Mueller Co.; Water Products Division
5. NIBCO INC>
6. Victaulic Company

- B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.9 TRIM AND DRAIN VALVES

- A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Conbraco Industries, Inc.; Apollo Valves
- b. Fire End & Coker Corporation
- c. Fire Protection Products, Inc.
- d. Flowserve.
- e. FNW; Ferguson Enterprises, Inc.
- f. Jomar International, LTD.
- g. Kitz Corporation
- h. Legend Valve.
- i. Metso Automation USA, Inc.
- j. Milwaukee Valve Company.

- k. NIBCO INC.
- l. Potter Roemer
- m. Red White Valve Corporation.
- n. Tyco Fire & Building Products LP.
- o. Victaulic Company
- p. Watts Water Technologies, Inc.

2. Description:

- a. Pressure Rating: 175 psig.
- b. Body Design: Two piece.
- c. Body Material: Forged brass or bronze.
- d. Port size: Full or standard.
- e. Seats: PTFE.
- f. Stem: Bronze or stainless steel.
- g. Ball: Chrome-plated brass.
- h. Actuator: Handlever.
- i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
- j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited the following:

- a. Fire Protection Products, Inc.
- b. NIBCO INC.
- c. Unied Brass Works, Inc.

2. Description:

- a. Pressure Rating: 175 psig
- b. Body Material: Brass or bronze.
- c. Ends: Threaded.
- d. Stem: Bronze.
- e. Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited the following:

- a. NIBCO INC.
- b. Unied Brass Works, Inc.

2. Description:

- a. Pressure Rating: 175 psig.
- b. Body Material: Bronze with integral seat and screw-in bonnet.
- c. Ends: Threaded.
- d. Stem: Bronze.
- e. Disc Holder and Nut: Bronze.
- f. Disc Seat: Nitrile.

- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
 - 1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
 - 2. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install check valve in each fire-protection water-supply connection. Install backflow preventers instead of check valves in potable water supply sources.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

- H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- I. Install check valve in each water supply connection. Install backflow preventers instead of check valves in potable water supply sources.

END OF SECTION 210523

SECTION 210553

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Carlton Industries, LP.

4. Champion America.
 5. Craftmark.
 6. emedco.
 7. Kolbi Pipe Marker Co.
 8. LEM Products Inc.
 9. Marking Services Inc.
 10. Seton Identification Products.
2. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025 inch aluminum, 0.032 inch or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Red.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless- steel rivets or self-tapping screws
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Carlton Industries, LP.
 4. Champion America.
 5. Craftmark.
 6. emedco.
 7. Kolbi Pipe Marker Co.
 8. LEM Products Inc.
 9. Marking Services Inc.
 10. Seton Identification Products
 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, , 1/8 inch thick, with predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Red.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three- fourths the size of principal lettering.
 8. Fasteners: Stainless--steel rivets or self-tapping screws.
 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

- D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by- 11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. 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. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Carlton Industries, LP.
 4. Champion America.
 5. Craftmark.
 6. emedco..
 7. LEM Products Inc.
 8. Marking Services Inc.
 9. National Marker Company.
 10. Seton Identification Products.
 11. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Red.
- E. Maximum Temperature: Able to withstand temperatures up to 160 degF.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three- fourths the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- 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. ActionCraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.

2. Brady Corporation.
 3. Brimar Industries, Inc.
 4. Carlton Industries, LP.
 5. Champion America.
 6. Craftmark.
 7. emedco.
 8. Kolbi Pipe Marker Co.
 9. LEM Products Inc.
 10. Marking Services Inc.
 11. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: Size letters according to ASME A13.1 for piping.
- F. Pipe-Label Colors:
1. Background Color: Safety Red.
 2. Letter Color: White.

2.4 STENCILS

- A. Stencils for Piping:
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. Brimar Industries, Inc.
 - b. Carlton Industries, LP.
 - c. Champion America.
 - d. Craftmark.
 - e. Kolbi Pipe Marker Co.
 - f. Marking Services Inc.
 2. Lettering Size: Size letters according to ASME A13.1 for piping.
 3. Stencil Material: Fireboard.
 4. Stencil Paint: Safety Red, exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 5. Identification Paint: White exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

- 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. ActionCraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
 2. Brady Corporation.
 3. Brimar Industries, Inc.
 4. Carlton Industries, LP.
 5. Champion America.
 6. Craftmark.
 7. emedco.
 8. Kolbi Pipe Marker Co.
 9. LEM Products Inc.
 10. Marking Services Inc.
 11. Seton Identification Products.
- B. Description: Stamped or engraved with with 1/4-inch letters for piping-system abbreviation and 1/2- inch numbers.
1. Tag Material: Brass, 0.032-inch stainless steel, 0.025 inch aluminum, 0.032 inch or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
 2. Fasteners: Brass Brass wire-link chain beaded chain or S-hook.
 3. Valve-Tag Color: Safety Red.
 4. Letter Color: White.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- 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. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Carlton Industries, LP.
 4. Champion America.
 5. Craftmark.
 6. emedco.
 7. Kolbi Pipe Marker Co.
 8. LEM Products Inc.
 9. Marking Services Inc.
 10. Seton Identification Products.
- B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches
 2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping: Painting of piping is specified in Section 099123 "Interior Painting".
- B. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, each piping system.
 1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit a view of concealed piping.
 5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 1. Valve-Tag Size and Shape:
 - a. Wet-Pipe Sprinkler System: 2 inches, square
 - b. Dry-Pipe Sprinkler System: 2 inches, square.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 210553

SECTION 211119
FIRE DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flush-type fire-department connections.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.1 FLUSH-TYPE FIRE-DEPARTMENT CONNECTION

- 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. AFAC Inc.
 - 2. Central Sprinkler Corp.
 - 3. Elkhart Brass Mfg. Co., Inc.
 - 4. Fire-End and Croker Corp.
 - 5. Fire Protection Products, Inc.
 - 6. GMR International Equipment Corporation.
 - 7. Guardian Fire Equipment Incorporated.
 - 8. Potter-Roemer; Fire-Protection Div.
 - 9. Reliable Automatic Sprinkler Co., Inc.
 - 10. United Brass Works, Inc.
- B. Standard: UL 405.
- C. Type: Flush, for wall mounting.
- D. Pressure Rating: 175 psig minimum.
- E. Body Material: Corrosion-resistant metal.
- F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

- G. Caps: Brass, lugged type, with gasket and chain.
- H. Escutcheon Plate: Rectangular, brass, wall type.
- I. Outlet: With pipe threads.
- J. Body Style: Horizontal.
- K. Number of Inlets: Two.
- L. Outlet Location: Top.
- M. Escutcheon Plate Marking: Similar to "AUTO SPKR".
- N. Finish: Chrome.
- O. Outlet Size: NPS 6.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall-type fire-department connections.
- B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211313
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Cover system for sprinkler piping.
 - 3. Sprinklers.
 - 4. Alarm devices.
 - 5. Manual control stations.
 - 6. Control panels.
 - 7. Pressure gauges.
- B. Related Requirements:
 - 1. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.

1.3 DEFINITIONS

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS.

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS.

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction:
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications.
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Office and Public Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design.
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - 4. Maximum Protection Area per Sprinkler: Per UL listing.
 - 5. Maximum Protection Area per Sprinkler.
 - a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
 - 1. Domestic water piping.
 - 2. Items penetrating finished ceiling include the following.
 - a. Lighting fixtures.

b. Air outlets and inlets.

- E. Qualification Data: For qualified Installer and professional engineer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Welding certificates.
- H. Fire-hydrant flow test report.
- I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping.
- J. Field quality-control reports.
- K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following.

- 1. NFPA 13, "Installation of Sprinkler Systems."

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Owner no fewer than five days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.9 COORDINATION.

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, console locations, rack equipment in equipment rooms and partition assemblies.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS.

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 40, Steel Pipe: ASTM A 135; ASTM A 795/A 795M, or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- D. Black Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- E. Steel Couplings: ASTM A865/A865M, threaded.
- F. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- J. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
- K. Grooved-Joint, Steel-Pipe Appurtenances:
 - 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. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
 3. Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- L. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175 psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
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. Victaulic Company.

2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- F. Copper, Pressure-Seal Fittings:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Viega; Plumbing & Heating Systems.
 2. Standard: UL 213.
 3. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 4. NPS 2-1/2 to NPS 4: Cast-bronze fitting with EPDM-rubber O-ring seal in each end.

2.4 PIPING JOINING MATERIALS.

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 LISTED FIRE-PROTECTION VALVES.

A. General Requirements.

- 1. Valves shall be UL listed or FM approved.
- 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
- 2. Standard: UL 1091 except with ball instead of disc.
- 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
- 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
- 5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
- 2. Standard: UL 1091.
- 3. Pressure Rating: 175 psig.
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

D. Iron Butterfly Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.

- f. NIBCO INC.
 - g. Pratt, Henry Company.
 - h. Shurjoint Piping Products.
 - i. Tyco Fire & Building Products LP.
 - j. Victaulic Company.
-
- 2. Standard: UL 1091.
 - 3. Pressure Rating: 175 psig.
 - 4. Body Material: Cast or ductile iron.
 - 5. Style: Lug or wafer.
 - 6. End Connections: Grooved.

E. Check Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Anvil International, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Fire-End & Croker Corporation.
 - f. Fivalco Inc.
 - g. Global Safety Products, Inc.
 - h. Kennedy Valve; a division of McWane, Inc.
 - i. Milwaukee Valve Company.
 - j. Mueller Co.; Water Products Division.
 - k. NIBCO INC.
 - l. Potter Roemer.
 - m. Reliable Automatic Sprinkler Co., Inc.
 - n. Shurjoint Piping Products.
 - o. Tyco Fire & Building Products LP.
 - p. United Brass Works, Inc.
 - q. Venus Fire Protection Ltd.
 - r. Victaulic Company.
 - s. Viking Corporation.
 - t. Watts Water Technologies, Inc.
- 2. Standard: UL 312.
- 3. Pressure Rating: 250 psig minimum.
- 4. Type: Swing check.
- 5. Body Material: Cast iron.
- 6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Mueller Co.; Water Products Division.
 - e. NIBCO INC.

- f. United Brass Works, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 175 psig.
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

G. Iron OS&Y Gate Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 250 psig minimum.
- 4. Body Material: Cast iron.
- 5. End Connections: Flanged or grooved

H. Indicating-Type Butterfly Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
- 2. Standard: UL 1091.
- 3. Pressure Rating: 175 psig minimum.
- 4. Valves NPS 2 and Smaller.
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.

- c. End Connections: Threaded.
- 5. Valves NPS 2-1/2 and Larger.
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
- 6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch visual indicating device.

I. NRS Gate Valves.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
- 2. Standard: UL 262.
- 3. Pressure Rating: 250 psig minimum.
- 4. Body Material: Cast iron with indicator post flange.
- 5. Stem: Nonrising.
- 6. End Connections: Flanged or grooved

2.6 TRIM AND DRAIN VALVES.

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

C. Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

- a. Anvil International, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Fire-End & Croker Corporation.
- d. Fire Protection Products, Inc.
- e. Flowserve.
- f. FNW.
- g. Kennedy Valve; a division of McWane, Inc.
- h. Legend Valve.
- i. Milwaukee Valve Company.
- j. NIBCO INC.
- k. Potter Roemer.
- l. Tyco Fire & Building Products LP.
- m. Victaulic Company.
- n. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

2.7 SPECIALTY VALVES.

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating.
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. AFAC Inc.
 - b. Global Safety Products, Inc..
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.8 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

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. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Victaulic Company.
 - d. Tyco Fire & Building Products LP.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

E. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- C. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.
- D. Automatic Sprinklers with Heat-Responsive Element:
 1. Early-Suppression, Fast-Response Applications: UL 1767

2. Nonresidential Applications: UL 199.
 3. Residential Applications: UL 1626
 4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- E. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
1. Nominal Orifice:
 - a. 1/2 inch with discharge coefficient K between 5.3 and 5.8.
 - b. 17/32 inch with discharge coefficient K between 7.4 and 8.2.
- F. Sprinkler Finishes: Chrome plated.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- H. Sprinkler Guards:
1. Standard: UL 199.
 2. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
1. Standard: UL 753.
 2. Type: Mechanically operated, with Pelton wheel.
 3. Alarm Gong: Cast aluminum with red-enamel factory finish.
 4. Size: 8-1/2-inches diameter.
 5. Components: Shaft length, bearings, and sleeve to suit wall construction.
 6. Inlet: NPS 3/4.
 7. Outlet: NPS 1 drain connection.
- C. Electrically Operated Notification Appliances:
1. Electric Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: 6-inch minimum diameter.
 - d. Voltage: 120 V ac, 60 Hz, 1 phase.
 - e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
 2. Strobe/Horn:

- a. Standard: UL 464.
- b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
- c. Voltage: 120 V ac, 60 Hz.
- d. Effective Intensity: 110 cd.
- e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
- f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police, or fire department.

D. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

E. Pressure Switches:

1. Standard: UL 346.
2. Type: Electrically supervised water-flow switch with retard feature.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. 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.

2.11 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
 - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
 - 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Manual Control Stations, Electric Operation: Metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Manual Control Stations, Hydraulic Operation: With union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- D. Panels Components:
 - 1. Power supply.
 - 2. Battery charger.
 - 3. Standby batteries.
 - 4. Field-wiring terminal strip.
 - 5. Electrically supervised solenoid valves and polarized fire-alarm bell.
 - 6. Lamp test facility.
 - 7. Single-pole, double-throw auxiliary alarm contacts.
 - 8. Rectifier.

2.13 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0 - to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gauge, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, check valve, pressure gauge, and drain at connection to water supply.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall and Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- N. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- P. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- R. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
- E. Air Vent:
 - 1. Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
 - 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.

3.8 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in the center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 DEMONSTRATION

- A. **Train** Owner's maintenance personnel to adjust, operate, and maintain **specialty valves**.

3.13 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

3. Standard-weight black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 4. Standard-weight galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
 5. Standard-weight black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 6. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 7. Standard-weight black-steel pipe with plain ends; steel welding fittings; and welded joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 shall be one of the following:
1. Standard-weight black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- F. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger shall be one of the following:
1. Standard-weight black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- G. High-pressure, wet-pipe sprinkler system, NPS 4 and smaller, shall be the following:
1. Standard-weight galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 3. Standard-weight black-steel pipe with plain ends; steel welding fittings; and welded joints.
- H. High-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:
1. Standard-weight galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.14 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220501

BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

- 1.1 All Drawings and the provisions of Divisions 00 and 01 of the Specifications apply to this and all other Sections of Division 22. In addition other portions of the Specifications should be consulted for various coordination purposes.
- 1.2 Applicable requirements of the Contract Documents, preceding the technical Specifications, apply to this Section. In the event of conflict between the Specifications, the most stringent shall apply.
- 1.3 Consult index to be certain that set of documents and Specifications is complete. Report omissions or discrepancies to the Owner's Representative.
- 1.4 Employ high standards of good workmanship and shall pay special attention to the safety of the equipment. The installation of material and equipment shall be in conformance with the codes and standards listed in Paragraph: STANDARDS. The agency having the most stringent requirements shall be adhered to.
- 1.5 Make a thorough examination of the site and shall make due allowances for difficulties and contingencies to be encountered. All dimensions shall be checked and verified by the Contractor at the site.
- 1.6 Sub-Contractors shall have a minimum of three years proven experience on projects with similar levels of complexity and magnitude. Experience shall be based on the experience as a company and not on the experience as individuals.
- 1.7 The Drawings and Specifications are intended to function as a common set of documents. Anything shown on the Drawings but not mentioned in the Specifications or mentioned in the Specifications and not shown on the Drawings, shall be equally binding as if both noted on the Drawings and called for in the Specifications.
- 1.8 SCOPE
 - A. The work covered by and included in these Specifications consists of the furnishing of all materials, all equipment, labor, tools and supervision and performing all operations necessary for the proper and complete execution of the Plumbing work in strict accordance with the Specifications and the Drawings and subject to the terms and conditions of the Contract.

1.9 DEFINITIONS

- A. The term "Contractor" or "Plumbing Sub-Contractor" when used in this Specification refers to the Contractor responsible for all work under this Section.
- B. The term "ATC" refers to Automatic Temperature Controls.

1.10 STANDARDS

- A. Meet requirements and recommendations of applicable portions of the latest edition of all codes and standards, as adopted by the local authority having jurisdiction, including those listed.
 - 1. American National Standards Institute Standards (ANSI).
 - 2. American Society of Mechanical Engineers (ASME).
 - 3. American Society for Testing and Materials Standards (ASTM).
 - 4. American Welding Society Standards (AWS).
 - 5. American Water Works Association (AWWA).
 - 6. 2018 Uniform Construction Code (PA-UCC).
 - 7. 2018 International Building Code (ICC).
 - 8. 2018 International Energy Conservation Code (IECC).
 - 9. 2018 International Plumbing Code (IPC).
 - 10. National Fire Protection Association Standards (NFPA).
 - 11. Occupational Safety and Health Administration (OSHA).
 - 12. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
 - 13. Underwriter's Laboratories Publication (UL).
 - 14. Regulations of the Pennsylvania State Police, Fire Marshall Division.
 - 15. Pennsylvania Department of Labor and Industry, Fire and Panic Regulations.
 - 16. Public Law 101-336, The Americans with Disabilities Act of 1990.
- B. Should any change in the Drawings and/or Specifications be required to conform to the codes, ordinances, regulations or laws mentioned above, the Owner's Representative shall be notified prior to the time of submitting bids.

1.11 NOTIFICATION

- A. Trades that have work connected with the Plumbing work and trades that do preparatory work for Plumbing shall be notified for installation requirements and scheduling.
- B. The Owner's Representative shall be informed of the installation schedule to allow sufficient time for inspection without any work delay.
- C. All work shall be coordinated to avoid cutting of work in place and interfering with other operations.
- D. In compliance with Act 38, contact individual companies to have utility locations marked in the field and to otherwise locate underground objects as may be necessary prior to the start of construction.
 - 1. Pennsylvania law requires three working days notice for the construction phase and ten working days in design stage. Call Pennsylvania One Call System, Inc. (1-800-242-1776, as of this writing).

1.12 CONTRACT DRAWINGS

- A. Contract Drawings are diagrammatic and indicate the relation of piping, ductwork, connections and equipment. The Drawings do not indicate all offsets, elbows and fittings that may be required. Therefore, the Contractor shall carefully investigate the structural and finish conditions affecting the work. Provide all offsets, elbows, fittings, hangers and accessories as may be required to meet these conditions at no additional cost to the Owner.
- B. Do not scale the Drawings. Check conditions at the site for dimensions and sizes pertaining to the structure.
- C. Do not deviate from the Drawings without prior approval.

1.13 LINES, GRADES AND SURVEYS

- A. All necessary surveys, lines, grades and measurements are the responsibility of the Sub-Contractor desiring the information for the proper installation of his work. Take responsibility for the proper installation of the work with respect to other Trades.
- B. Grades, elevations and locations shown on the Drawing are approximate. Check all such information on the site before proceeding with the work.

1.14 WORKMANSHIP

- A. All equipment, piping, conduit, insulation, fixtures, etc. shall be installed meeting the accepted standards of the representative industry.
- B. All work to be performed shall be done by qualified mechanics. All mechanics employed on this project shall be skilled in the phases of the work to which they are used. The mechanic's affiliation with labor organizations shall be acceptable to all trades employed on the project.

1.15 SUBMITTAL PROCEDURES

- A. Transmit each submittal with an Owner's Representative accepted form. Include one copy each for the Owner and the Owner's Representative in addition to copies required by Contractor.
- B. Sequentially number the transmittal forms. Resubmittals shall have original number with an alphabetic suffix.
- C. Identify Project, Contractor, Sub-Contractor or Supplier; pertinent drawing sheet and detail number and specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- E. Incomplete submittals shall not relieve the Sub-Contractor of providing a complete and functional system.
- F. Schedule submittals to expedite the Project. Coordinate submission of related items.

- G. Submittals must be in complete compliance with the Contract Documents unless exceptions are identified. Exceptions to the Contract Documents may only be made to improve the project. Exceptions cannot be taken which would provide an incomplete and/or nonfunctional system.
- H. Exceptions must be included in/on the submittal in a separate paragraph or drawing block located below the Contractor's stamp identified by the title "Exception to Contract Documents." Exceptions cannot be part of the standard Contractor's stamp.
- I. Provide space for Contractor and Owner's Representative review stamps.
- J. The Owner's Representative will return shop drawings with the following designations.
 - 1. Approved: Further submission not required.
 - 2. Approved as Noted: Corrections must be incorporated in final installation. Further submission not required unless specifically noted.
 - 3. Noted: Placed in project files for information only.
 - 4. Revise and Resubmit: Make necessary changes and resubmit prior to fabrication.
 - 5. Not Approved: Does not meet project requirements. Resubmit in accordance with Contract Documents.
- K. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- L. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.16 SHOP DRAWINGS/PRODUCT DATA

- A. Submit shop drawings and/or catalog cuts for all specified equipment.
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.
- D. Show equipment sizes and locations, by dimensions, of ducts, equipment and other items.
- E. Include wiring diagrams, hole location and sizes and other data that could affect work by other trades.
- F. Show manufacturer's names, trade names, catalog numbers, accessories, special features and rating data.
- G. Indicate required clearances for operating parts, for removal and for servicing.
- H. Show performance data, including pump curves.
- I. Show sound power levels of all rotating equipment.

1.17 SUBSTITUTIONS

- A. Any bidder wishing to substitute "or equal" equipment may request a substitution. Manufacturers which are submitted as substitutions for approved equal status are considered to have equipment of similar quality; however, the Sub-Contractor shall not assume that a piece of equipment by a manufacturer submitted as a "substitution" will be automatically accepted. Compliance with the Drawings and Specifications is still required. If the substituted material is considered to be unacceptable, the Sub-Contractor shall provide the equipment as originally specified.
- B. Substitutions are encouraged when there is a significant cost savings or an improvement to the project. Submit reasons for changes with any requests for substitution.
- C. Bid alternates shall be clearly defined on the bid forms in order to be evaluated during the bidding process.
- D. By submitting an alternate or substitution, the Sub-Contractor automatically agrees to the following:
 - 1. The Owner shall be reimbursed by the Sub-Contractor for any additional costs incurred by the Owner's Representative to review the substituted materials, in accordance with the then current Owner's Representative's hourly rate.
 - 2. The Owner shall be reimbursed by the Sub-Contractor for any additional costs incurred by the Owner's Representative for field or office conferences caused by the substituted materials shall be paid ~~by the Contractor~~ in accordance with the then current Owner's Representative's hourly rate.
 - 3. The consideration of alternates/substitutions does not obligate the Owner's Representative to accept same.
 - 4. In the event a brand is approved and substituted, it is the responsibility of the Sub-Contractor to so coordinate his substituted material into the original work at no extra cost to the Owner or any other Contractor.

1.18 CUTTING AND PATCHING

- A. In new construction, give the General Contractor complete information as to size of openings required in floors and walls, etc., so that such openings may be provided as the project progresses. In existing construction, the Sub-Contractor shall do his own cutting and patching required for the installation of his work.
- B. If openings are omitted or are incorrect through failure of the Sub-Contractor to follow these instructions, engage the trade which originally installed the work, to cut and patch to the satisfaction of the Owner's Representative.
- C. All cutting and patching of every nature required in connection with this Contract shall be done with mechanics experienced in their respective lines of work. All patching shall match adjacent finishes.
- D. All cutting in the building shall be done with great care so as not to leave an unsightly surface, which may not be concealed by plates, escutcheons or other normal concealing construction. If such unsightly conditions occur, engage the General Contractor to replace the damaged materials with new materials.

1.19 CONCRETE AND MASONRY WORK

- A. Unless otherwise noted, all concrete bases, reinforcing, etc. and masonry work required to install the respective Contract Work shall be furnished and installed by the respective Trade.
- B. Furnish all materials, labor, equipment and tools necessary to complete concrete work.
- C. All concrete work shall comply with the requirements of the ACI Building Code (ACI 318), the ACI Detailing Manual (ACI 315) and the Specifications for Structural Concrete for Buildings (ACI 30).
- D. All reinforcing steel shall be manufactured from high strength billet steel conforming to ASTM Designation A-615, Grade 60. WWF shall comply with ASTM A-185.

1.20 MATERIALS

- A. All materials and equipment provided shall be new, without imperfections and blemishes and shall be protected from the elements prior to installation in the building.
- B. All equipment shall be tested, listed and labeled by an approved authority (UL, AGA, ETL) and shall be installed in accordance with its listing.
- C. All equipment subject to specific requirements of the Owner's insurance company (gas trains, etc.) shall meet the insurance companies requirements.

1.21 METHODS

- A. Confer with all other Trades and shall apply for detailed and specific information regarding the location of all equipment as the final location may differ from that indicated on the Drawings. Piping or equipment improperly placed because of failure to obtain this information shall be relocated and reinstalled without additional expense to the Owner.
- B. Each Trade upon request of the Owner's Representative, shall expedite the work of a specific area, section or part of the project to permit the installation of another part of the work.
- C. All piping, accessories and equipment shall be installed in such a manner as to preserve access with sufficient space provided for proper operation and maintenance to any existing equipment or to any new equipment installed under this Specification or under other Specifications or Contracts for this building.
- D. Coordinate this work with that of other trades so that all work may be installed in the most direct manner and so that interference between piping, ducts, equipment, architectural or structural features will be avoided. In the case interference results, the Owner's Representative shall decide which work is to be relocated, regardless of which is first installed. Such relocation shall be at no additional cost to the Owner.
- E. All materials and equipment installed shall be firmly supported and secured to the building structure where required.
- F. All items of labor, material and equipment not specified in detail or shown on the Drawings but incidental to, or necessary for, the complete and proper installation and proper operation of the work described herein or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Specifications or Drawings.

- G. Provide isolation valves and unions or flanges at all pieces of equipment and at all branch take-offs serving five or more pieces of equipment to facilitate replacement or service of the equipment.
- H. All equipment shall be installed in accordance with the manufacturer's recommendations and installation instructions. The manufacturer's installation instructions shall be considered part of this Contract.

1.22 SCHEDULING OF WORK

- A. Attend all planning meetings, provide scheduling information and work with all trades to obtain a workable project schedule that meets the Owner's requirements.

1.23 PROTECTION

- A. Effectively protect this work and materials with tarpaulins or heavy plastic material against dirt, water, chemicals, plaster or damage during the entire period of installation or until directed to remove the coverings by the Owner's Representative. Any damaged material must be removed and replaced by the Contractor without additional cost regardless of the cause of the damage. All openings in pipes, fittings, etc., must be effectively sealed to exclude dirt, sand and other foreign substances.

1.24 PROTECTION OF OWNER'S EQUIPMENT

- A. Provide any temporary work required to protect the Owner's equipment and to contain the dust generated during construction. Any measures taken for the protection of equipment shall be installed to the satisfaction of the Owner or the Owner's Representative, which may include any and all provisions listed in Division 01 - General Requirements and/or in accordance with the appropriate technical specifications for wood and plastics in Division 06. An approved protection material is nylon reinforced flame retardant and anti-static Griffolyn T-75 ASFR 8 mil film.

1.25 DELIVERING AND STORAGE OF MATERIALS AND EQUIPMENT

- A. Deliver accessories, small, unmarked parts, adhesives and incidental items to site in manufacturer's original, unopened, labeled containers.
- B. Store materials and equipment to prevent damage and injury. Store ferrous materials to prevent rust. Store equipment to prevent staining and discoloring.

1.26 AS-BUILT DRAWINGS

- A. During construction, the Contractor shall maintain a record set of red lined installation prints. He shall record on these prints, all deviations from the Contract Drawings in pipe sizing, duct sizing, equipment, pipe or duct location, depth of pipe cover and details.
- B. At the completion of the work, the Contractor shall transfer this information onto one set of prints and onto computer generated construction documents and forward the as-built prints and an electronic copy to the Owner's Representative. Electronic copies of mechanical

drawings, without title blocks, will be made available to the Contractor in AutoCAD as a .dwg file.

1.27 OPERATION AND MAINTENANCE INSTRUCTIONS.

- A. Prior to completion of this project, the Contractor shall deliver to the Owner's Representative for approval three copies of an Operating and Maintenance Manual consisting of items outlined hereinafter.
- B. The purpose of this manual is to assist the Owner in routine operation, maintenance, servicing, troubleshooting and procurement of replacement parts. All information in the manual shall be as-built and only material pertinent to the project shall be included.
- C. The manual shall include the following:
 - 1. Manuals shall be bound, 8-1/2 x 11 inch text pages and set in three-ring binders with durable covers.
 - 2. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of project and subject matter of binder when multiple binders are required. All subject matter shall be in typewritten format.
 - 3. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab labeling clearly printed under reinforced laminated plastic tabs.
 - 4. Contents: Prepare a Table of Contents for each volume with product or system description identified, type on white paper.
 - 5. Part 1: Directory, listing names, addresses and telephone numbers of Owner's Representative, Contractor, Sub-Contractors and major equipment suppliers.
 - 6. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses and telephone numbers of Sub-Contractors and suppliers. Operating and start-up instructions shall be written in a concise step-by-step manner. Maintenance instructions shall include maintenance schedules, procedures, adjustments and troubleshooting techniques. All non-pertinent information in the manuals shall be either eliminated or crossed out in a neat and thorough manner. Identify the following:
 - a. List of equipment
 - b. Parts list for each component
 - c. Operating instructions
 - d. Maintenance instructions for equipment and systems
 - 7. Part 3: Project documents and certificates, including the following:

- a. Corrected shop drawings and product data
 - b. Control wiring diagrams
 - c. Certificates
 - d. Photocopies of warranties
 - e. Valve tag list
8. Submit one copy of completed volumes in final form 30 days prior to final inspection. This copy will be returned after final inspection, with the Owner's Representative's comments. Revise content of documents as required prior to final submittal.
9. Submit final volumes revised, within ten days after Owner's review.

1.28 IDENTIFICATION OF MATERIALS AND EQUIPMENT

- A. Label concealed and exposed piping not more than 25 feet on centers and adjacent to all valves and equipment for easy identification. This does not apply to control compressed air, underground pipe or pipe located within walls. Show flow arrows and medium conveyed in the pipe. Labels shall conform to ANSI A13.1 for color, letter size and marker length.
- B. Identify starters, fans, air conditioning units and other equipment with permanent plates giving name of item, manufacturer's name and operating characteristics.
- C. Show, for items with moving parts, complete information regarding lubricating materials and frequency of lubrication.
- D. Valve tags shall be provided on all valves. Tags shall be two inches in diameter, brass, Style 300-BL as manufactured by Seton Name Plate Corporation. Each tag shall be securely fastened to the valve stem with brass "S" hooks. Additional tags shall be fastened on ceiling tiles or access doors to further identify concealed valves.
- E. Each tag shall be stamped showing the system name, valve identification number, function and position (i.e., N.O., N.C., Balancing Two-Way, Modulating, etc.).
- F. Provide a typewritten valve list segregated by systems, showing valve number, equipment served or system function and location in building by room and nearest column. The list should be on 8-1/2 x 11 inch paper bound in plastic binder and three copies submitted to the Owner or the Owner's Representative for approval and after approval, six copies for final information.

1.29 PAINTING

- A. Where factory finishes are provided and no additional field painting is specified; all marred or damaged surfaces shall be touched up or refinished to a smooth and uniform finish.
- B. All exposed ferrous metalwork, pipe, supports, hangers, insulation and other surfaces not factory painted shall be painted with one prime and two finish coats. Paint, surface preparation and application shall be as specified in Section 099100 - Painting. Colors shall match existing work or shall be as selected by the Owner's Representative.

1.30 LAWS, ORDINANCES AND REGULATIONS

- A. All systems in all and/or part shall conform to all pertinent laws, ordinances and regulations of ALL bodies having jurisdiction, at all governing levels. In case of conflict between governing levels, the more stringent law shall apply. As a minimum, all work shall comply with BOCA, NFPA, OSHA and Pennsylvania Labor and Industry requirements.
- B. Pay all fees, prepare and submit all utility applications and obtain and pay for all permits and inspections required for his work, including L&I pressure vessel installation plans, inspections and approvals.

1.31 BUILDING EXPANSION JOINTS AND FIRE RATED ASSEMBLIES

- A. Provide expansion joints in piping where they cross building expansion joints.
- B. Meet all requirements of Underwriter's Laboratories and all applicable codes for maintaining the integrity of all fire rated assemblies.

1.32 ACCESS DOORS

- A. The Contractor shall provide access panels/access doors for access to valves, balancing valves or cocks, water hammer arrestors, cleanouts or any other equipment or component requiring access for maintenance, adjustment or service wherever these items are concealed in building walls, partitions or ceilings. Frames shall be anchored in walls, partitions or ceilings and shall be set true to lines of the building and flush with the finished surfaces. Access panels/access doors shall be as specified in Section 083113.

1.33 FASTENING, SUPPORTS AND HANGERS

- A. All fastenings, supports, hangers, miscellaneous steel, clamps and anchors shall be type made for specific purpose to be used; toggle bolts or machine bolt fastenings shall be used for hollow tile, terra cotta or lath construction; machine screws shall be used for structural steel fastenings; lead expansion shield and machine screws or lag screws shall be used for solid masonry fastening; lag screws shall be used for wood fastening; all equipment and piping shall be rigidly and firmly installed to prevent swaying, vibrating or sagging by malleable or wrought steel hangers of standard design, pipe clamps or fabricated steel supports of approved design; hangers of horizontal piping runs shall be adjustable clevis type; perforated strap iron hangers and caddy clips are not permissible.

1.34 SOUND PARTITIONS

- A. Identify all sound partitions indicated on the architectural plans. Seal all penetrations through the wall to maintain the sound absorption integrity of the partition.

1.35 CONCRETE INSERTS

- A. Provide and install concrete inserts of an approved carbon steel wedge-type for all hangers. Where two or more parallel pipes are installed continuous inserts may be used. Where required to distribute the load on the inserts, a piece of reinforcing steel of sufficient length

shall be passed through the insert. Each insert shall include a knockout piece. Inserts shall have a minimum safety factor of five.

1.36 SLEEVES

- A. Provide and install sleeves where required to protect equipment or facilities in the installation. Each sleeve shall extend through its respective floor, wall, or partition and shall be cut flush with each surface unless otherwise required.
- B. Sleeves in bearing and masonry walls, floors and partitions shall be of standard weight steel pipe finished with smooth edges. For other masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 U.S.G. galvanized iron.
- C. All sleeves shall be properly installed and securely cemented in place.
- D. Floor sleeves shall extend one inch above the finished floor. Space between floor sleeves and passing conduit shall be caulked with an approved graphite packing or waterproof caulking compound.
- E. Where pipes pass through waterproofed floors or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
- F. Where piping or conduits pass through fire resisting portions of the structure, the annular space between the sleeve and the pipe or conduit shall be filled with an approved fireproof material as required to maintain the fire rating of that portion of the structure. "Firestop Penetrator", or "Proseal Plug Devices" as manufactured by ProSet Systems (or approved equal) shall be used for piping and conduit.
- G. See architectural drawings for fire ratings of building components.

1.37 FIRE STOPPING

- A. Provide and install fire-stopping materials and/or systems where work penetrates fire and/or smoke rated portions of the building and non-fire resistance-rated assemblies. All materials used shall be manufactured such that they are intended to resist the spread of fire and the passage of smoke. This includes but is not limited to rated walls, floors, shafts, ceilings, and non-fire resistance-rated horizontal assemblies. All fire stopping materials used shall have a fire resistance rating equal to or greater than the rated assembly for which they are installed.
- B. For locations where the installed fire stopping material is exposed to normal view, conceal the material with chrome-plated escutcheon plates or other materials that have a flame-spread value of 25 or less and a smoke developed rating of 50 or less, as determined per ASTM E 84. The concealing device shall be approved by the owner's representative prior to installation. Provide shop drawings for each device.
- C. Provide components/accessories for each fire-stopping system that are needed to install fill materials and to comply with all system performance requirements as recommended by the fire stopping material manufacturer. Accessories include but are not limited to: mineral wool insulation, ceramic fiber, sealants used to aid in the formation of the fire stopping materials, fire-rated formboard, joint fillers and sealers, collars and steel sleeves.
- D. Fire stopping materials and systems shall include, but are not limited to, the following: fire barrier caulk and sealants, intumescent caulk, intumescent putty, intumescent wrap strips,

silicone foams and sealants, fire barrier composite sheets and cast-in-place fire barrier systems.

- E. Fire stopping materials and systems shall be as manufactured by 3M Fire Protection Products, Hilti Corporation, or ProSet Systems Inc.

1.38 ANCHOR BOLTS

- A. Provide and set in place, at the time of pouring of concrete foundations, all necessary anchor bolts as required for the equipment called for in these Specifications. Anchor bolts shall be of the hook type, of proper size and length to suit the equipment. Anchor bolts shall be set in pipe sleeves of approximately twice the bolt diameter and one half the embedded length of the bolt. Assume full responsibility for proper coordination and placement of the bolts. Upon completion of equipment installation, pipe sleeves shall be caulked in accordance with Paragraph, "Sleeves," in this Section of the Specifications.

1.39 WARRANTY

- A. The systems specified herein shall be guaranteed to be free from defects in workmanship and material under normal use and service for a period of one year (five years for all compressors) from date of substantial completion.
- B. If, within the aforementioned warranty period, any of the materials specified herein is proven to be defective in any way, it shall be replaced or repaired at no additional cost to the Owner. The warranty shall include the providing of all labor and materials necessary for repair or replacement of any defective components. Be responsible for the costs of any services required by equipment suppliers that are not included in the suppliers' warranties.
- C. After acceptance of the installation by the Owner or the Owner's Representative, provide any service incidental to the proper performance of the systems under the warranties outlined above for the time periods listed above.

END OF SECTION

SECTION 220502
SPECIAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by and included in these Specifications consists of the furnishing of all materials, all equipment, labor, tools and supervision and performing all operations necessary for the proper and complete execution of the Plumbing work in strict accordance with the Specifications and the Drawings and subject to the terms and conditions of the Contract.

1.2 WORK IN THE EXISTING BUILDING

- A. Be responsible for thoroughly surveying the existing building to determine the extent and cost of installing new equipment and materials in the existing building.
- B. All new equipment and materials shall be installed in the existing building as herein specified.
- C. Before starting any cutting of the present building, first obtain approval from the Owner's Representative on the site before cutting at each location. Provide any temporary work required to retain the dust generated by this work as may be directed by the Owner's Representative. All dust found, which has escaped the area of cutting, shall be properly removed by the Contractor without additional cost to the Owner.
- D. All openings cut into the exterior of the existing structure must be completely sealed and waterproofed before leaving the job site each day.
- E. Do not assume utilities can be installed as shown. Drawings are diagrammatic and utilities may need to shift to accommodate existing conditions. It is believed that in general the project can be constructed with utilities in approximately the locations as shown.
- F. Construction phasing could require installation of some temporary feeds and system shutdowns to accommodate construction.

1.3 INTERRUPTION OF SERVICES

- A. Schedule this work to avoid any interruption of any utility services to the operation areas of the building during normal working hours. Interruption of services shall be done during off hours at no additional cost to the Owner.
- B. Notify the Owner and the Owner's Representative at least three days prior to any interruption of services. The scheduling of all interruptions shall be approved by the Owner.

1.4 DEMOLITION

- A. Perform all demolition work as indicated on the Drawings and as described below as part of this Contract.
- B. Cut and patch as required to perform the demolition work. All openings created must be repaired to match existing conditions.
- C. Any materials and equipment not desired by the Owner shall become the property of the Sub-Contractor and shall be removed promptly from the project site. Disposal shall be in accordance with the regulations of the authorities at the disposal site.

1.5 COORDINATION DRAWINGS

- A. In addition to the required manufacturer and "field" Shop Drawing submittals, all trades shall participate in the preparation of composite coordination drawings.
- B. Each trade shall show planned mechanical/plumbing work on minimum 3/8" = 1'-0" layout drawings (plan & section views) and participate in a minimum of 15 coordination meetings initiated by the General Contractor. Meetings shall include installers of plumbing, HVAC, fire protection, insulation, and electrical work.
- C. Under the General Contractor's supervision, the ductwork sub-contractor shall prepare composite utility/service drawings which overlay all trades' work.
- D. The completed drawings shall show interfaces of ductwork, electrical conduit and cable trays, fire protection and plumbing lines sized 1-1/2 inch and above (diameters include exterior insulation). All drain lines shall be illustrated regardless of size to insure adequate "fall" is achievable in concealed cavities.
- E. Prepare drawings to show clearances for installing and maintaining insulation, breaking down equipment, pulling tubes, replacing filters and motors, valve stem movement and similar requirements.
- F. Provide details and sections as needed to conclusively show successful coordination and integration of work.
- G. Access door requirements to satisfy the needs of Paragraph E shall be located.
- H. Professional will not supervise coordination which is the exclusive responsibility of the Contractor.

END OF SECTION

SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel Sheet Sleeves: 0.023-inch minimum thickness; round tube closed with welded longitudinal joint.
- E. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
- F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- 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:

Smith, Jay R. Mfg. Co.
Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- 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:

Advance Products & Systems, Inc.
CALPICO, Inc.
Metraflex Company (The).
Pipeline Seal and Insulator, Inc.
Proco Products, Inc.

- B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- 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:

- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

- C. Unit has Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

- B. Design Mix: 5000 psi, 28-day compressive strength.

- C. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1 inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide ¼ inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Resistance-Rated Penetrations, Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 3. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 4. Using grout to seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations, Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Use grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel wall sleeves
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel wall sleeves with sleeve-seal system
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: PVC-pipe sleeves.

END OF SECTION 220517

SECTION 220518
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With white plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with white finish and spring-clip fasteners.
- C. Split-Casting Brass Type: With polished, white finish and with concealed hinge and setscrew.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners. Split-Casting Floor Plates: White Plated Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.

- b. White Piping: One-piece, cast-brass or split-casting brass type with polished, white finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, white finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, white finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, white finish.
 - f. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with rough-brass finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor plate.
 - 2. Existing Piping: Split floor plate, floor plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze lift check valves.
3. Bronze swing check valves.
4. Iron swing check valves.
5. Balancing Valves.
6. Drain Valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 DEFINITIONS.

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.3 SUBMITTALS.

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

- B. ASME Compliance.
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Prepare valves for shipping as follows.
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types.
 - 1. Hand lever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With valve stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections: Match pipe joining method.
 - 1. Solder Joint: With sockets according to ASME B16.18.

2. Threaded: With threads according to ASME B1.20.1.

- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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:

Beeco.
Crane Co.; Crane Valve Group; Crane Valves.
Conbraco Industries, Inc.; Apollo Valves.
Hammond Valve.
Milwaukee Valve Company.
NIBCO INC.
Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 200 psig minimum, match plans for greater pressures.
- c. Body Design: Two piece.
- d. Body Material: Bronze.
- e. Ends: SOLDER.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

2.3 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze or non-metallic Disc

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Crane Co.
Kitz Corporation.
Hammond Valve.
Milwaukee Valve Company.
NIBCO INC.
Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80.
- b. CWP Rating: 200 psig minimum, match plans for greater pressures.
- c. Body Design: Horizontal flow.

- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

ITT Industries; Bell & Gossett Div.
NIBCO INC.
Taco, Inc.
Watts Industries, Inc.; Water Products Div.

2. Type: Ball or globe valve with two readout ports and memory setting indicator.
3. Body: bronze.
4. Size: Same as connected piping.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.5 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves.

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP:
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.
- B. Set field-adjustable flow set points of balancing valves.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following.
 - 1. Shutoff Service.
 - a. NPS 3 and smaller: Ball valve.
 - 2. Throttling Service: Ball.
 - 3. Sewage and sump basin discharge to have swing check valves with optional lever and weight or lever and spring, for quiet operation.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves with the following end connections;
 - 1. NPS 3 and smaller: Match the piping system joining method.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE.

- A. Pipe NPS 3 and Smaller: Bronze ball valves.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

Carpenter & Paterson, Inc.
Clement Support Services.
ERICO International Corporation.

National Pipe Hanger Corporation.
PHS Industries, Inc.
Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
Piping Technology & Products, Inc.
Rilco Manufacturing Co., Inc.
Value Engineered Products, Inc.

- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: : ASTM C 552, Type II cellular glass with 100- psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- B. Stainless Steel: ASTM A240/A240M.
- C. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP 89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP 89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Stand Installation:
 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- F. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.

- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - 5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use corrosion-resistant attachments for hostile environment applications.

- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 7. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 8. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 9. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 11. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 2. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.

- c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder actuated fasteners or mechanical expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to be included in maintenance manuals.

1.4 COORDINATION.

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

1. Material and Thickness Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black
3. Background Color: White
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater

viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions:
 - 1. Stencil Material: Aluminum.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or

space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 1. Domestic Water Piping
 - a. Background: Yellow.
 - b. Letter Colors: Black.
 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - 2. Valve-Tag Colors:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - 3. Letter Colors:
 - a. Cold Water: Black.
 - b. Hot Water: Black.

END OF SECTION

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," and "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.
- D. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
 - 2. 850 deg F.
 - 3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Solvent-based adhesive.
 - 1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
 - 2. Wet Flash Point: Below 0 deg F.
 - 3. Service Temperature Range: 40 to 200 deg F.
 - 4. Color: Black.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: 0 to plus 180 deg F.
 - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
 - 4. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: 0 to 180 deg F.
 - 3. Color: White.
- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 3. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 - 2. Service Temperature Range: 0 to plus 180 deg F.
 - 3. Color: White.

2.5 LAGGING ADHESIVES

- A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

2. Service Temperature Range: 20 to plus 180 deg F.
3. Color: White.

2.6 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 1. Permanently flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 58 to plus 176 deg F.
 3. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
 1. Fire- and water-resistant, flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 3. Color: Aluminum.
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 1. Fire- and water-resistant, flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 3. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils.
 - 3. Adhesion: 64 ounces force/inch in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 18 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
 - 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel, or Monel.

2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
 - 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Piping, Exposed:
 - 1. PVC: 30 mils thick.

END OF SECTION 220719

SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Piping joining materials.
 - 3. Transition fittings.
- B. Related Requirements:

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Pipe and tube.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Transition fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than five (5) days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

- A. Annealed-Temper Copper Tube: ASTM B88, Type K and ASTM B88, Type L.
- B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- D. Wrought Copper Unions: ASME B16.22.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig minimum at 180 deg F.
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Nipples:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple complying with ASTM F1545.
 - 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 4. End Connections: Male threaded or grooved.
 - 5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
 - 1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

3.2 EARTHWORK

- A. Comply with requirements in Section 312300 "Excavation and Backfill" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping to permit valve servicing.
- H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- L. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Install hangers for copper piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections, and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum relief valve.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Temperature-actuated, water mixing valves.
 - 5. Strainers for domestic water piping.
 - 6. Outlet boxes.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Water-hammer arresters.
 - 10. Trap-seal primer device.
 - 11. Flexible connectors.

1.3 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.

- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM RELIEF VALVE

1. A Watts Model N36-M1 Vacuum Relief Valve shall be installed on domestic hot water supply tanks/ heaters/ unit heaters/ steam kettles as indicated on plans. The vacuum relief valve shall be ANSI Z21.22 rated and CSA certified. The vacuum relief valve shall have an all brass body and include a protective cap.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 1. Standard: ASSE 1013.
 2. Operation: Continuous-pressure applications.
 3. Pressure Loss: 12 psig maximum, through middle third of flow range.
 4. Size: 3 inch.
 5. Design Flow Rate: 90 GPM.
 6. Pressure Loss at Design Flow Rate: 10 psig.
 7. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 9. Configuration: Designed for horizontal, straight-through flow.
 10. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 BALANCING VALVES

- A. Memory-Stop Balancing Valves:
 - 1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 2. Pressure Rating: 400-psig minimum CWP.
 - 3. Size: NPS 2 or smaller.
 - 4. Body: Copper alloy.
 - 5. Port: Standard or full port.
 - 6. Ball: Chrome-plated brass or stainless steel.
 - 7. Seats and Seals: Replaceable.
 - 8. End Connections: Solder joint or threaded.
 - 9. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
 - 1. Standard: ASSE 1017.
 - 2. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 3. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
 - 4. Material: Bronze body with corrosion-resistant interior components.
 - 5. Connections: Threaded union inlets and outlets.
 - 6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 7. Tempered-Water Setting: 130 F.
 - 8. Valve Finish: Rough bronze.
 - 9. Piping Finish: Copper.
- B. Individual-Fixture, Water Tempering Valves:
 - 1. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
 - 2. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 3. Material: Bronze body with corrosion-resistant interior components.
 - 4. Temperature Control: Adjustable.
 - 5. Connections: Threaded inlets and outlets.
 - 6. Finish: Chrome plated.
 - 7. Tempered-Water Setting: 110 F.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 - 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
 - 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 - 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.062 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.125 inch.
 - c. Strainers NPS 5 and Larger: 0.25 inch.
 - 6. Drain: Factory-installed, hose-end drain valve.

2.8 HOSE BIBBS

- A. Hose Bibbs:
 - 1. Standard: ASME A112.18.1 for sediment faucets.
 - 2. Body Material: Bronze.
 - 3. Seat: Bronze, replaceable.
 - 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 6. Pressure Rating: 125 psig.
 - 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 - 9. Finish for Service Areas: Rough bronze.
 - 10. Finish for Finished Rooms: Chrome or nickel plated.
 - 11. Operation for Equipment Rooms: Wheel handle or operating key.
 - 12. Operation for Service Areas: Operating key.
 - 13. Operation for Finished Rooms: Operating key.
 - 14. Include operating key with each operating-key hose bibb.
 - 15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants:
 - 1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 - 2. Pressure Rating: 125 psig.
 - 3. Operation: Loose key.
 - 4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 - 5. Inlet: NPS 3/4 or NPS 1.
 - 6. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 - 7. Box: Deep, flush mounted with cover.
 - 8. Box and Cover Finish: Polished nickel bronze.
 - 9. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 - 10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
 - 11. Operating Keys(s): Two with each wall hydrant.

2.10 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 - 2. Pressure Rating: 400-psig minimum CWP.
 - 3. Size: NPS 3/4.
 - 4. Body: Copper alloy.
 - 5. Ball: Chrome-plated brass.
 - 6. Seats and Seals: Replaceable.
 - 7. Handle: Vinyl-covered steel.
 - 8. Inlet: Threaded or solder joint.

9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.11 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 1. Standard: ASSE 1010 or PDI-WH 201.
 2. Type: Metal bellows, Piston or Diaphragm.
 3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
 1. Standard: ASSE 1018.
 2. Pressure Rating: 125 psig minimum.
 3. Body: Bronze.
 4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.13 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.

3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Y-Pattern Strainers: For water, install where indicated on the drawings.
- F. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- G. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- H. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- I. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Vacuum relief valves.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Outlet boxes.
 - 7. Hose stations.
 - 8. Wall hydrants.
 - 9. Trap-seal primer device.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections.
 - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.

- 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221123.21
INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail pumps and adjacent equipment, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

- B. Taco, Grundfos, Watts
- C. Capacities and Characteristics are as shown on drawings.
- D. Pump Construction:
 - 1. Casing:
 - a. Radially split **bronze** with threaded companion-flange connections.
 - b. Built to permit servicing of pump internals without disturbing the casing or the suction and discharge piping.
 - c. Gauge port tapings at suction and discharge nozzles.
 - 2. Impeller: Bronze statically and dynamically balanced, closed, and keyed to shaft.
 - 3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
 - 4. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 - 5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
 - 6. Bearings: permanently lubricated ball type.
 - 7. Minimum Working Pressure: 175 psig.
 - 8. Continuous Operating Temperature: 225 deg F.
- E. Motor: Single speed, with grease-lubricated ball bearings.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Type: Water-immersion temperature sensor, for installation in piping.
 - 2. Range: 50 to 125 deg F.
 - 3. Enclosure: NEMA 250.
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Power Requirement: 120 V ac.
 - 7. Settings: Start pump at 105 deg F.
- B. Timers: Electric, for control of hot-water circulation pump.
 - 1. Type: Programmable, seven-day clock with manual override on-off switch.
 - 2. Enclosure: NEMA 250, suitable for wall mounting.
 - 3. Operation of Pump: On or off.
 - 4. Transformer: Provide if required.
 - 5. Power Requirement: 120 V ac.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
- D. Install thermostats in hot-water return piping.
- E. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.
- F. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set thermostats and timers for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.
 - 9. Adjust temperature settings on thermostats.
 - 10. Adjust timer settings.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, close-coupled centrifugal pumps.

- b. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:

3.3 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.
- C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Hubless, cast-iron soil pipe and fittings.
 - 2. PVC Pipe and fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect, Construction Manager and Owner no fewer than five (5) days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's and Owner's written permission.

1.6 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and CISPI 310.
 - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and ASTM C 1540.
 - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- E. Cast-Iron, Hubless-Piping Couplings:
 - 1. Standard: ASTM C 1277.
 - 2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

- 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- 2. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 3. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
- 4. Pressure Transition Couplings:
 - a. Standard: AWWA C219.
 - b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - c. Center-Sleeve Material: [Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron].
 - d. Gasket Material: Natural or synthetic rubber.
 - e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: [125 psig minimum at 180 deg F] [150 psig] [250 psig] <Insert pressure>.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: [125 psig minimum at 180 deg F] [150 psig] [175 psig] [300 psig] <Insert pressure>.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
3. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: [150 psig] <Insert pressure>.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
4. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: [300 psig at 225 deg F] <Insert pressure and temperature>.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the minimum slopes as indicated on the drawings:
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install steel piping according to applicable plumbing code.
- O. Install aboveground PVC piping according to ASTM D 2665.
- P. Install underground PVC piping according to ASTM D 2321.
- Q. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.

3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

R. Plumbing Specialties:

1. Install backwater valves in sanitary waste gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 1. Cut threads full and clean using sharp dies.

2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- G. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 1. Install transition couplings at joints of piping with small differences in ODs.
 2. In Waste Drainage Piping: [Unshielded] [Shielded], nonpressure transition couplings.
 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 2. Dielectric Fittings for [NPS 2] <Insert pipe size> and Smaller: Use dielectric [nipples] [unions].
 3. Dielectric Fittings for [NPS 2-1/2 to NPS 4] <Insert pipe size range>: Use dielectric [flanges] [flange kits] [nipples].
 4. Dielectric Fittings for [NPS 5] <Insert pipe size> and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 220523 for valve installation requirements.
- B. Shutoff Valves:
 1. Install shutoff valve on each sewage pump discharge.

2. Install gate or full-port ball valve for piping NPS 2 and smaller.
 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.
 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." and Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- F. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 6. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; and coupled joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Extra Heavy Service class, cast-iron soil piping; gaskets; and gasketed calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; coupled joints.
3. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 - 1. Standard: ASME A112.36.2M.
 - 2. Size: Same as connected drainage piping
 - 3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure: Countersunk, brass plug.
 - 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
 - 1. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 - 2. Size: Same as connected branch.
 - 3. Type: Threaded, adjustable housing.
 - 4. Body or Ferrule: Cast iron.
 - 5. Clamping Device: Required.
 - 6. Outlet Connection: Threaded.
 - 7. Closure: Brass plug with straight threads and gasket.
 - 8. Adjustable Housing Material: Cast iron with threads.
 - 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 10. Frame and Cover Shape: Round.
 - 11. Top-Loading Classification: Heavy Duty.
 - 12. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. Standard: ASME A112.36.2M. Include wall access.
 - 2. Size: Same as connected drainage piping.
 - 3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure Plug:
 - a. Cast iron.
 - b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 - 5. Wall Access, Cover Plate: Round, deep, chrome-plated bronze cover plate with screw.
 - 6. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Deep-Seal Traps:
 - 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 - 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.
- B. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- E. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- F. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- G. Install vent caps on each vent pipe passing through roof.
- H. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- I. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- J. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13

SANITARY DRAINS

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. Floor drains.
 - 2. Trench Drains

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Acceptable Manufacturers
 - a. Jay R. Smith
 - b. Sioux Chief
 - c. Watts
 - d. Zurn
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron
5. Seepage Flange: Required.
6. Anchor Flange: Provide if required, coordinate with installation conditions.
7. Clamping Device: Provide if required, coordinate with finished flooring.
8. Outlet: Bottom
9. Coating on Interior and Exposed Exterior Surfaces: Not required.
10. Sediment Bucket: As scheduled.
11. Top or Strainer Material: As scheduled.
12. Top of Body and Strainer Finish: As scheduled.
13. Top Shape: As scheduled.
14. Dimensions of Top or Strainer: As scheduled.
15. Inlet Fitting: Provide with trap primer fitting or ASSE 1072 compliant mechanical trap barrier.

2.3 TRENCH DRAINS

A. Trench Drains:

1. Acceptable Manufacturers
 - a. Jay R. Smith
 - b. Sioux Chief
 - c. Watts
 - d. Zurn
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: Anchor.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Grate Material: Ductile iron.
8. Grate Finish: Painted.
9. Top Loading Classification: Heavy Duty.
10. Trap Pattern: Standard P-trap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.
- D. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 221616
NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Joining materials for piping and tubing.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Service meters.
 - 7. Mechanical sleeve seals.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roofs, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Anodless Risers and Sweeps: Fittings that can be installed without additional cathodic protection.

1.3 PERFORMANCE REQUIREMENTS

- A. Natural-Gas System Pressure within Buildings: 2-psig or less.
- B. Operating Pressure Ratings:
 - 1. Piping and Valves: 100-psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65-psig minimum unless otherwise indicated.
 - 3. Operating Pressure of Service Meter: 5-psig minimum unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Dielectric fittings.

6. Mechanical sleeve seals.
7. Escutcheons.

B. Shop Drawings: Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail locations of anchors, alignment guides, and expansion joints and loops. Include a site plan, on which natural-gas piping is indicated and coordinated with other services and utilities.

1. Shop Drawing Scale: Not less than $1/4" = 1'-0"$.

C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

D. Installer Qualifications.

E. Welding Certificates.

F. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and service meters, include data in operation, and maintenance manuals.

G. Record Drawings: Indicate, at $1/4" = 1'-0"$ scale, the actual natural-gas piping installation layout and elevations, sections, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer that is experienced in the installation of natural-gas piping of the types required for the Project, and whose work has resulted in a record of successful in-service performance. Installer licensed to perform natural-gas piping installation and maintenance in the project jurisdiction.

B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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. Regulatory Requirements: Natural-gas piping installations shall comply with the International Fuel Gas Code, 2000 edition.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose flammable liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps throughout shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored polyethylene pipes and valves from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility- locating service for area where Project is located.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate installation of anchorages for natural-gas systems. 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. Deliver such items to Project site in time for installation and to not cause a delay in the Work.
- C. Coordinate requirements for access panels and doors for valves and controls installed concealed behind finished surfaces, and for areas requiring routine maintenance. Comply with requirements in Division 08 Section "Access Doors and Frames."

1.9 WARRANTY

- A. Refer to Division 01 60 00 Product Requirements specification for warranty registration requirements.
- B. Special Warranty: Submit written warranty, executed by the manufacturer and Installer, agreeing to repair or replace components that develop defects in material or workmanship within the specified warranty period.
 - 1. Warranty Period for Natural-Gas Systems: One year from date of Substantial Completion, or eighteen months from date of shipment, whichever is greater.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the manufacturers indicated for each component:
 - 1. Appliance Flexible Connector: No preference.
 - 2. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Lyall, R. W. & Company, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Perfection Corporation; a subsidiary of American Meter Company.
 - 3. Bronze Plug Valves:

- a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
4. Cast-Iron, Non-lubricated Plug Valves:
- a. McDonald, A. Y. Mfg. Co.
 - b. Mueller Co.; Gas Products Div.
 - c. Xomox Corporation; a Crane company.
5. Cast-Iron, Lubricated Plug Valves:
- a. Flowserve.
 - b. McDonald, A. Y. Mfg. Co.
 - c. Mueller Co.; Gas Products Div.
 - d. R&M Energy Systems, a Unit of Robbins & Myers, Inc.
6. Automatic Gas Valves:
- a. ASCO Power Technologies, LP; Division of Emerson.
 - b. Eaton Corporation; Controls Div.
 - c. Eclipse Combustion, Inc.
 - d. Honeywell International Inc.
 - e. Johnson Controls.
7. Electrically Operated Valves:
- a. ASCO Power Technologies, LP; Division of Emerson.
 - b. Eclipse Combustion, Inc.
 - c. Goyen Valve Corp.; Tyco Environmental Systems.
 - d. Magnatrol Valve Corporation.
 - e. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
 - f. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
8. Line Pressure Regulators:
- a. Eclipse Combustion, Inc.
 - b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - c. Invensys.
 - d. Maxitrol Company.
 - e. Richards Industries; Jordan Valve Div.
9. Appliance Pressure Regulators:
- a. Eaton Corporation; Controls Div.
 - b. Harper Wyman Co.
 - c. Maxitrol Company.
 - d. SCP, Inc.
10. Dielectric Unions: No preference.
11. Dielectric Flanges: No preference.
12. Mechanical Sleeves: No preference.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

B. Polyethylene (PE) Pipe: ASTM D2513, SDR 11 (Underground Piping Only).

1. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet. Underground piping to receive factory-applied, three layer coating of epoxy, adhesive, and polyethylene.
 - b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 - h. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink polyethylene sleeves.
4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive and polyethylene.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.

4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.0.5-psig End Fittings: Zinc-coated steel.
6. Threaded Ends: Comply with ASME B1.20.1.
7. Maximum Length: 72-inches.

B. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50-percent free area.
4. CWP Rating: 125-psig.

C. Basket Strainers:

1. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125-psig.

D. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 57-percent free area.
4. CWP Rating: 750-psig.

E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural-gas pipe.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 MANUAL GAS SHUTOFF VALVES

- A. Refer to Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125-psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

4. Tamperproof Feature: Locking feature for valves indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch diameter and smaller.
 6. Service Mark: Valves NPS 1-1/4 to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125-psig.
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Body: Complying with ASTM B584.
1. Ball: Chrome-plated bronze.
 2. Stem: Bronze; blowout proof.
 3. Seats: Reinforced TFE; blowout proof.
 4. Packing: Threaded-body packnut design with adjustable-stem packing.
 5. Ends: Threaded, flared, or socket as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
 6. CWP Rating: 600-psig.
 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
1. Body: Bronze, complying with ASTM B584.
 2. Plug: Bronze.
 3. Ends: Threaded, socket, or flanged as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
 4. Operator: Square head or lug type with tamperproof feature where indicated.
 5. Pressure Class: 125-psig.
 6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Cast-Iron, Non-lubricated Plug Valves: MSS SP-78.
1. Body: Cast iron, complying with ASTM A126, Class B.
 2. Plug: Bronze or nickel-plated cast iron.
 3. Seat: Coated with thermoplastic.
 4. Stem Seal: Compatible with natural-gas.
 5. Ends: Threaded or flanged as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
 6. Operator: Square head or lug type with tamperproof feature where indicated.
 7. Pressure Class: 125-psig.
 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL

- acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with natural-gas.
5. Ends: Threaded or flanged as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125- psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with embossed cover with letters "GAS".
3. Bottom section with base to fit over valve and a minimum 5-inches diameter barrel.
4. Adjustable cast-iron extensions of length required for depth of embedment.
5. Include tee-handle, steel operating wrench with socket end fitting, either valve nut or flat head, with stem of length required to operate valve.

2.6 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.

1. Pilot operated.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. 120-V ac, 60-Hz, Class B, continuous-duty molded coil, and replaceable.
6. NEMA ICS 6, Type 4, coil enclosure.
7. Normally closed.
8. Visual position indicator.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural-gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.

2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 1.5 times the design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 2-psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 2-psig

2.8 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Minimum Operating-Pressure Rating: 150-psig.
2. Combination fitting of copper alloy and ferrous materials.
3. Insulating materials suitable for natural-gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Minimum Operating-Pressure Rating: 150-psig
2. Combination fitting of copper alloy and ferrous materials.
3. Insulating materials suitable for natural-gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.9 SLEEVES

A. Steel Pipe Sleeves: ASTM A53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.10 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space

between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.11 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Stamped-Steel Escutcheons: With set screw and chrome-plated finish.
- D. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw, and chrome-plated finish.
- E. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.12 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6-inches wide and 4-mils thick, continuously inscribed with a description of utility and the word "CAUTION", and colored yellow.
- B. Safety Tracer Wire: Metallic core (copper minimum AWG 14) encased in a protective insulated jacket for corrosion protection, detectable by metal detector when tape is buried up to 36-inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural-gas to premises or piping section.
- B. Inspect natural gas piping according to the International Fuel Gas Code to determine that natural gas utilization devices are turned off in piping section(s) affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Underground Installations: Install underground natural-gas piping according to ASTM D2774.
 - 1. Locate natural-gas piping between 18-and 30-inches below finished grade, except in areas subjected to vehicular traffic, where natural-gas piping shall be located between 24- and 30-inches below finished grade. In all cases, when the backfilled trench is to be compacted, the natural-gas piping shall be placed at a depth sufficient to ensure the piping will be covered by not less than 18- inches of backfill material. Comply with requirements in Division 31 Section "Earthwork" for excavating, trenching, and backfilling.
 - 2. At building, PE piping shall extend to a point 12-inches above finished grade with shut-off valve on either end.
 - 3. Install a safety tracer wire along the entire length of underground piping. Extend safety tracer wire to a point 12-inches above finished grade on the outside gas riser.
 - 4. Provide a continuous detectable warning tape 12-inches below finished grade, directly above - the entire length of the underground piping. Install detectable warning tape 6-inches below subgrade under paved areas and slabs.
 - 5. Line the trench bottom with a 3-inches thick bedding layer of clean sand, taking care to ensure the pipe will be uniformly and continuously supported over its entire length. Place PE pipe. Cover pipe with clean sand, not less than 6-inches above top of pipe, prior to backfilling the trench. Cover the sand with not less than 12-inches of excavated soil, free of rocks, frozen clods, or debris greater than 3-inches diameter, prior to compacting the backfilled trench.
- C. Steel Piping with Protective Coating (Above Ground Only):
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Replace pipe having damaged protective coating with new pipe.
- D. Aboveground Natural-Gas Piping:
 - 1. Pipe Diameter – 2-inches Diameter and Smaller: Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Pipe Diameter – Larger than 2-inches Diameter: Steel pipe with wrought-steel fittings and welded joints.
 - 3. Concealed Piping: All concealed natural-gas piping shall have welded joints.
- E. Install fittings for changes in direction and branch connections.
 - 1. Anodeless risers, pieces, or sweeps shall be used when rising up from soil and when penetrating basement walls. Anodeless components shall be secured to the foundation with proper brackets when used as risers.
- F. Above-ground, Exterior Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6-inches diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6-inches [diameter](#) and larger.
- G. Exterior Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- H. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- I. Exterior Rooftop Pipe Installation:
 - 1. Rooftop piping should meet the requirements of above ground natural gas piping in the paragraphs above.
 - 2. Support steel piping above roof with pillow block support system equal to Miro Industries model 3- R or 3-RAH. Support system shall consist of polycarbonate base mounted on elastomeric walk pad or support pad. Support system should include pipe rollers to allow movement.
 - 3. Exterior Roof Pipe Penetrations: Penetration of all piping through the roof shall be through pipe curb cap assembly with sealed neoprene boots equal to Pate Company model pca-2 or equal.
- J. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
- K. All outdoor gas piping shall be painted yellow.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved by Architect on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building surfaces. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install escutcheons at penetrations of interior walls, ceilings, and floors.
 - 1. New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - c. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - d. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
 - e. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - f. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- N. Drips and Sediment Traps: Provide drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- P. Concealed natural-gas piping shall be installed according to the International Fuel Code.
- Q. Natural-gas piping valves and regulators shall not be installed in concealed spaces.
1. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 2. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator hoistways.
 - b. Do not install natural-gas piping in solid walls or partitions.
 - c. Do not install natural-gas piping underground below building slabs.
- R. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- S. Connect branch piping from top or side of horizontal piping.
- T. Provide unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- U. Do not use natural-gas piping as grounding electrode.

- V. Provide strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- W. Provide pressure gage upstream and downstream from each pipe regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.5 VALVE INSTALLATION

- A. Provide manual gas shutoff valve for each gas appliance ahead of appliance flexible connector. Valve shall be located in same room as equipment.
- B. Provide outdoor underground valves with valve boxes.
- C. Provide a shutoff valve, acceptable to the authority having jurisdiction, on the outside riser.
- D. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- E. Provide anode for metallic valves in underground PE piping.
- F. Provide pressure reducing valve at each equipment and appliance with relief piped outdoors.
- G. As a minimum install automatic gas shut off valve with alarm or remote operation for kitchen equipment motor hood with fire suppression system.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
- D. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Provide gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for Piping and Equipment."
- B. Provide hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 2. NPS 1-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.8 CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Provide tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.
- E. Connect wiring according to Division 26 Section "Conductors and Cables".

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC" for piping and valve identification.
- B. Below Grade: Provide detectable warning tape continuously and directly above gas piping, 12-inches below finish grade; 6-inches below sub-grade under pavements and concrete slabs.
- C. Labeling and identification materials are specified in Division 22 "Identification for Plumbing Piping and Equipment".

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Test, inspect, and purge natural-gas according to the International Fuel Gas Code and authorities having jurisdiction.

- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 OUTDOOR PIPING SCHEDULE

- A. Underground Natural-Gas Piping: Polyethylene (PE) pipe and fittings joined by heat fusion, or mechanical coupling. Service-line riser with tracer wire shall be terminated in an accessible location.
- B. Aboveground Natural-Gas Piping: Steel pipe, with joints as indicated in Article, "Outdoor Piping Installation."

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 2 PSIG

- A. Aboveground piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints smaller or equal to NPS 2.
 - 2. Steel pipe with steel welding fittings and welded joints NPS 2-1/2 and larger.
 - 3. All concealed natural-gas piping shall be in a double wall configuration and vented to the outdoors.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, non-lubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, lubricated plug valve.
- E. Valves in branch piping for single appliance shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.

END OF SECTION 231123

SECTION 223300
ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, electric, storage, domestic-water heaters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports..
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Two years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradford White model scheduled or comparable product by one of the following:
 - a. Bradford White
 - b. A.O. Smith
 - c. Rheem
 - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 - 3. Standard: UL 1453.

4. Storage-Tank Construction: **Non-ASME-code**, steel **horizontal** or **vertical** arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - c. Insulation: Comply with ASHRAE/IES 90.1.
 - d. Jacket: Steel with enameled finish or high-impact composite material.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide AMTROL model ST-5 or comparable product by one of the following:
 - a. Armstrong
 - b. Bell & Gossett
 - c. Watts
2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed..

- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than **NPS 3/4** with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE/IES 90.1.
- E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig maximum outlet pressure unless otherwise indicated.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- F. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill electric, domestic-water heaters with water.
- I. Charge domestic-water expansion tanks with air to required system pressure.
- J. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
- 3.2 PIPING CONNECTIONS
- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain **commercial** electric, domestic-water heaters.

END OF SECTION 223300

SECTION 223400

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Commercial, direct-vent, gas-fired, storage, domestic-water heater.
 - 2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale and coordinated with all building trades.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: One year.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters:
 1. Bradford white, AO Smith, Rheem
 2. Standard: ANSI Z21.10.3/CSA 4.3.
 3. Storage-Tank Construction: **[Non-]**ASME-code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 4. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: For use with atmospheric, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Ignition: Standing pilot or ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.

- i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
- j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for fuel-oil piping specified in Section 231113 "Facility Fuel-Oil Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION 223400

SECTION 224213.13
COMMERCIAL WATER CLOSETS

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. Water closets.
 - 2. Flushometer valves.
 - 3. Toilet seats.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED WATER CLOSETS

- A. Water Closets: Floor mounted, P-1 and P-2 shall be top spud and P-16 shall be back spud, accessible where noted on drawings.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard model scheduled or comparable product by one of the following:
 - a. Kohler
 - b. Sloan
 - c. Toto
 - 2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.

- b. Material: Vitreous china.
- c. Type: Siphon jet.
- d. Style: Flushometer valve.
- e. Height: Standard/ADA as indicated on drawings.
- f. Rim Contour: Elongated.
- g. Water Consumption: 1.6 gal. per flush.
- h. Spud Size and Location: NPS 1-1/2; top.

2.2 FLUSHOMETER VALVES

- A. P-1 and P-2: Exposed Electronic, Battery Powered, Sensor Operated.
- B. P-16: Concealed Electronic, Hard Wired, Sensor Operated.
- C. Reference: Sloan Model G2. Or comparable product by one of the following
 - 1. American Standard
 - 2. Kohler
 - 3. Sloan
 - 4. Toto

2.3 TOILET SEATS

- A. Toilet Seats:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard model scheduled or comparable product by one of the following:
 - a. Bemis Manufacturing Company.
 - b. Church Seats.
 - c. Olsonite Seat Co.
 - 2. Standard: IAPMO/ANSI Z124.5.
 - 3. Material: Plastic, anti-microbial protected.
 - 4. Type: Commercial (Standard).
 - 5. Shape: Elongated rim, open front.
 - 6. Hinge: Self-sustaining.
 - 7. Hinge Material: Noncorroding metal.
 - 8. Color: White.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Water-Closet Installation:
 - 1. Install level and plumb according to roughing-in drawings.
 - 2. Install accessible water closets at mounting height for handicapped/elderly, according

to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color.

3.2 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping".
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping".
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.3 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 22421

SECTION 224213.16
COMMERCIAL URINALS

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. Urinals.
 - 2. Flushometer valves.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

- A. Urinals - Wall Hung, Back Outlet, Siphon Jet,: Accessible.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard model as scheduled or comparable product by one of the following:
 - a. Kohler Co.
 - b. Sloan.
 - c. Zurn
 - 2. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5/CSA B45.15.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
 - e. Water Consumption: 0.5 gl per flush

- f. Spud Size and Location: NPS $\frac{3}{4}$ top.
 - g. Outlet Size and Location: NPS 2; back.
 - h. Color: White.
- 3. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - b. Size: NPS 2.
- 4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

- A. Exposed Electronic, Battery, Sensor Operated Flushometer Valves.
- B. Reference: Sloan model scheduled or equivalent product by
 - 1. American Standard
 - 2. Zurn

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Urinal Installation:
 - 1. Install urinals level and plumb according to rough-in drawings.
 - 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
 - 3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC A117.1.
- B. Support Installation:
 - 1. Install supports, affixed to building substrate, for wall-hung urinals.
 - 2. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- C. Flushometer-Valve Installation:
 - 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
 - 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- D. Wall Flange and Escutcheon Installation:
 - 1. Install wall flanges or escutcheons (supplied with flush valve) at piping wall penetrations in exposed, finished locations.
 - 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
- E. Joint Sealing:
 - 1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.

2. Match sealant color to urinal color.

3.2 CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.3 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13
COMMERCIAL LAVATORIES

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. Lavatories.
- 2. Faucets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory: Vitreous China, wall mounted.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard Model specified or comparable product by one of the following:
 - a. Gerber Plumbing Fixtures LLC.
 - b. Kohler Co.
 - c. Mansfield Plumbing Products LLC.
 - d. Peerless Pottery Sales, Inc.
 - 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.

- b. Type: For wall hanging.
 - c. Nominal Size: As Scheduled
 - d. Faucet-Hole Punching: As Scheduled
 - e. Faucet-Hole Location: As Scheduled
 - f. Color: White.
 - g. Mounting: For concealed-arm carrier.
3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

2.3 SOLID-BRASS, SENSOR OPERATED FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Sensor Operated, above deck mixing, battery powered, commercial, solid-brass valve.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan model scheduled or comparable product by one of the following:
 - a. Bradley Corporation.
 - b. Chicago Faucets.
 - c. Delta Faucet Company.
 - d. Elkay Manufacturing Co.
 - e. Kohler Co.
 - f. Moen Incorporated.
 - g. T & S Brass and Bronze Works, Inc.
 - 2. Standard: ASME A112.18.1/CSA B125.1.
 - 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
 - 4. Body Type: Centerset.
 - 5. Body Material: Commercial, solid brass.
 - 6. Finish: Polished chrome plate.
 - 7. Maximum Flow Rate: 0.5 gpm.
 - 8. Mounting Type: Deck.
 - 9. Valve Handle(s): Color coded lever handler.
 - 10. Spout: Rigid type.
 - 11. Spout Outlet: Aerator.
 - 12. Drain: Not part of faucet.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
 - 1. NPS 3/8.
 - 2. Chrome-plated, soft-copper flexible tube or ASME A112.18.6, braided- or corrugated- stainless-steel, flexible hose riser.

2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/4.
 - 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch thick brass tube to wall or two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch thick brass tube to wall; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for

Plumbing Piping."

- E. Seal joints between lavatories and counters and walls using sanitary-type, one-part, mildew- resistant silicone sealant. Match sealant color to fixture color.
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16

COMMERCIAL SINKS

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. Mop Sink
 - 2. Breakroom sinks.
 - 3. Sink faucets.
 - 4. Supply fittings.
 - 5. Waste fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 SINKS

- A. Breakroom Sinks - Stainless Steel, double bowl.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Sink and Faucet or comparable product by one of the following:
 - a. Elkay
 - b. Eagle Group; Foodservice Equipment Division.
 - c. Griffin Products, Inc
 - d. Just Manufacturing.
 - 2. Fixture:

- a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Ledge back.
 - c. Number of Compartments: two
 - d. Overall Dimensions: 25" x 6"
 - e. Material: 18 gauge, stainless steel.
 - f. Compartment:
 - 1) Drain: Grid with NPS 1-1/2, tailpiece NPS 1-1/2 tailpiece with dishwasher connection.
 - 2) Drain Location: Near back of compartment.
3. Faucet:
 - a. Chrome plated brass with gooseneck spout.
 - b. Economy aerator.
 - c. Wrist blade handles.
4. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Loose key.
 - 2) Risers: NPS ½, chrome-plated, rigid-copper pipe, chrome-plated, soft-copper flexible tube or ASME A112.18.6, braided or corrugated stainless-steel flexible hose
5. Waste Fittings:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 1-1/2.
 - 2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch thick brass tube to wall; and chrome-plated brass or steel wall flange.
 - 3) Provide tailpiece with dishwasher connection.

B. Service Sinks - Molded Stone, Floor Mounted:

1. Fiat, Mustee, Zurn
2. Fixture:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Shape: Square.
 - c. Nominal Size: 24 by 24 inches.
 - d. Height: 10 inches.
 - e. Rim Guard: On front surfaces.
 - f. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.
4. Faucet: Wall mount with integral vacuum breaker with 3/4" threaded hose connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install water-supply piping with stop on each supply to each sink faucet.
 1. Install stops in locations where they can be easily reached for operation.
- C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- D. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.

- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224223
COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Individual showers.
 - 2. Shower heads and shower valves.
- B. Related Requirements:

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Shower valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 INDIVIDUAL SHOWERS

- A. Individual, One-Piece, FRP Showers without Top:
 - 1. Clarion Bathware, Kohler, Mustee
 - 2. General: FRP shower enclosure with valve and receptor and appurtenances.
 - 3. Standard: CSA B45.5/IAPMO Z124.
 - 4. Style: Handicapped/accessible.
 - 5. Shower Nominal Size and Shape: P-10: 38"x37" and P-11: 63"x33"
 - 6. Color: Coordinate with Architect.
 - 7. Outlet: Drain with NPS 2 outlet.
 - 8. Shower Rod: Required.
 - 9. Grab Bar: ASTM F446, mounted on support area back wall.

2.3 SHOWER HEADS AND SHOWER VALVES

A. Shower Head with Single-Handle, Pressure-Balanced Mixing Valve:

1. Watts, Kohler, Zurn
2. Description: Single-handle, accessible, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and hose with handheld shower head.
3. Shower Valve:
 - a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016/ASME A112.1016/CSA B125.16.
 - b. Body Material: Solid brass.
 - c. Finish: Polished chrome plate.
 - d. Mounting: Concealed.
 - e. Operation: Single-handle control.
 - f. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
4. Supply Connections: NPS 1/2.
5. Shower Head:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Shower Head Maximum Flow Rate: 1.5 gpm.
 - c. Shower Head Material: Metallic with chrome-plated finish.
 - d. Spray Pattern: Fixed.
 - e. Integral Volume Control: Required.

2.4 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble shower components according to manufacturers' written instructions.
- B. Install showers level and plumb.
- C. Install ball valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" Install valves in locations that are accessible for ease of operation.
- D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

- E. Set shower receptors in leveling bed of cement grout.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ADJUSTING

- A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.
- B. Adjust water pressure at shower valves to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. After completing installation of showers, inspect and repair damaged finishes.
- B. Clean showers, shower valves, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of showers for temporary facilities unless approved in writing by Owner.

END OF SECTION 224223

SECTION 224500
EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Emergency showers.
 - 2. Water-tempering equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- B. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ISEA Standard: Comply with ISEA Z358.1.

- C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.
- D. Regulatory Requirements: Comply with requirements in ICC A117.1, ; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

2.2 EMERGENCY SHOWERS

- A. Freestanding, Plumbed Emergency Showers,
 - 1. Bradley, Hughs, Haws
 - 2. Capacity: Not less than 20 gpm for at least 15 minutes.
 - 3. Supply Piping: NPS 1 galvanized steel with flow regulator and stay-open control valve.
 - 4. Control-Valve Actuator: Pull rod.
 - 5. Shower Head: 8-inch minimum-diameter, chrome-plated brass.
 - 6. Mounting: Pedestal.

2.3 WATER-TEMPERING EQUIPMENT

- A. Hot- and Cold-Water, Water-Tempering Equipment,
 - 1. Bradley, Hughs, Haws
 - 2. Description: Factory-fabricated equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
 - b. Supply Connections: For hot and cold water.

2.4 SOURCE QUALITY CONTROL

- A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION OF EMERGENCY PLUMBING FIXTURE

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball or gate valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached

for operation. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

- E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- G. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- I. Fill self-contained fixtures with flushing fluid.

3.2 CONNECTIONS

- A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."
- B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."
- C. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.
- E. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.3 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION 224500

**SECTION 224716
PRESSURE WATER COOLERS**

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 pressure water coolers and related components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Surface Wall-Mounted, Stainless Steel:
 - 1. Elkay, Haws, Oasis.
 - 2. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - 3. Control: Push bar.
 - 4. Bottle Filler: Sensor activation with 20-second automatic shutoff timer.
 - 5. Drain: Grid with NPS 1-1/4 tailpiece.
 - 6. Supply: NPS 3/8 with shutoff valve.
 - 7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
 - 8. Filter: One or more water filters with capacity sized for unit peak flow rate.

9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
10. Support: Water-cooler carrier.
11. Water-Cooler Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.
12. Capacities and Characteristics:
 - a. Cooled Water: 8 gph.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball, gate, or globe shutoff valve on water supply to each fixture.
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary

Waste and Vent Piping."

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

SECTION 230501
BASIC HVAC REQUIREMENTS

PART 1 – GENERAL

- 1.1 Applicable requirements of the Contract Documents, preceding the Technical Specifications, apply to this Section. In the event of conflict between the Specifications, the most stringent shall apply.
- 1.2 Separation of these Specifications into Divisions and Sections is for convenience only and is not intended to establish limits of work.
- 1.3 Consult index to be certain that set of Documents and Specifications is complete. Report omissions or discrepancies to the Owner's Representative.
- 1.4 The Contractor shall employ high standards of good workmanship and shall pay special attention to the safety of the equipment. The installation of material and equipment shall be in conformance with the codes and standards listed in Paragraph: STANDARDS. The agency having the most stringent requirements shall be adhered to.
- 1.5 The Contractor shall make a thorough examination of the site and shall make due allowances for difficulties and contingencies to be encountered. All dimensions shall be checked and verified by the Contractor at the site.
- 1.6 The Contractor and all Sub-Contractors shall have a minimum of three years proven experience on projects with similar levels of complexity and magnitude. Experience shall be based on the experience as a company and not on the experience as individuals.
- 1.7 The Drawings and Specifications are intended to function as a common set of documents. Anything shown on the Drawings but not mentioned in the Specifications or mentioned in the Specifications and not shown on the Drawings shall be equally binding as if both noted on the Drawings and called for in the Specifications.
- 1.8 SCOPE
 - A. The work covered by and included in these Specifications consists of the furnishing of all materials, all equipment, labor, tools and supervision and performing all operations necessary for the proper and complete execution of the Heating, Ventilating and Air Conditioning work in strict accordance with the Specifications and the Drawings and subject to the terms and conditions of the Contract.
- 1.9 DEFINITIONS

- A. The term "Contractor" or "HVAC Contractor" or "Mechanical Contractor" when used in this Specification refers to the Contractor responsible for all work under this Section.
- B. The term "Provide" refers to this Contractor purchasing, delivering and installing as a part of this Contract.
- C. The term "HVAC" refers to Heating, Ventilating and Air Conditioning.
- D. The term "ATC" refers to Automatic Temperature Controls.

1.10 STANDARDS

- A. Meet requirements and recommendations of applicable portions of the latest edition of all codes and standards, as adopted by the local authority having jurisdiction, including those listed.
 - 1. Air Movement and Control Association Standards (AMCA)
 - 2. 210 Laboratory Methods of Testing Fans for Rating Purposes
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
 - a. 52 Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
 - b. 90-1 Energy Efficient Design for New Building
 - 4. American National Standards Institute Standards (ANSI)
 - a. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
 - b. ANSI/ASME B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - c. ANSI/ASME B31.1 Power Piping
 - 5. American Society of Mechanical Engineers (ASME)
 - a. Boiler and Pressure Vessel Code and Interpretations Section VIII; Unfired Pressure Vessels (latest edition with addenda)
 - 6. American Society for Testing and Materials Standards (ASTM)
 - a. A-18 Carbon Steel Forgings For General Purpose Piping
 - b. A-234 Piping Fittings of Wrought Carbon Steel and Alloy Steel For Moderate and High Temperature Service
 - c. A-53 Welded and Seamless Steel Pipe
 - d. B-88 Seamless Copper Water Tube
 - e. E-84 Surface Burning Characteristics of Building Materials
 - f. C-411 Test Method for Hot Surface Performance of High Temperature Thermal Insulation
 - 7. American Welding Society Standards (AWS)

- a. B3.0 Qualification Procedure
- 8. 2018 Uniform Construction Code - State of PA (PA-UCC)
- 9. Pennsylvania Code Title 34, Labor and Industry
- 10. 2018 International Building Code (IBC)
- 11. 2018 International Mechanical Code (IMC)
- 12. 2018 International Energy Conservation Code (IECC)
- 13. NFPA 101 Code for Safety to Life from Fire in Buildings and Structures
- 14. National Fire Protection Association Standards (NFPA)
 - a. 70 National Electrical Code (NEC)
 - b. 90A Installation of Air Conditioning and Ventilating Systems
 - c. 96 Ventilation Control and Fire Protection of Commercial Cooking Operations
 - d. 255 Surface Burning Characteristics of Building Materials
- 15. The Hydronics Institute Publications (HI) I=B=R Testing and Rating Code for Finned Tube (Commercial) Radiation (latest edition)
- 16. Occupational Safety and Health Administration (OSHA)
- 17. Public Law 101-336, The Americans with Disabilities Act of 1990
- 18. Sheet Metal and Air Conditioning Contractors National Association, Inc., Publication (SMACNA)
 - a. HVAC Duct Construction Standards: Metal and Flexible, Second Edition
 - b. Seismic Restraint Manual: Guidelines For Mechanical Systems, Second Edition
- 19. Air Conditioning and Refrigeration Institute (ARI)
 - a. ANSI/ARI 210/240 Unitary Air Conditioning Equipment and Air Source Heat Pump Equipment
 - b. ANSI/ARI 410 Forced Circulation Air-Cooling and Air-Heating Coils
 - c. ANSI/ARI 430 Central Station Air Handling Units
 - d. ANSI/ARI 550 Centrifugal and Rotary Screw Water-Chilling Packages
- 20. Underwriters Laboratories Publication (UL)
 - a. 1025 Electric Air Heaters
 - b. 1995 Heating and Cooling Equipment
- 21. The Facility Guidelines Institute (FGI)
 - a. 2018 Guidelines for the Design and Construction of Hospitals
 - b. 2018 Guidelines for the Design and Construction of Outpatient Facilities

- c. 2018 Guidelines for the Design and Construction of Residential Health, Care and Support Facilities

22. Regulations of the Pennsylvania State Police, Fire Marshall Division

23. Pennsylvania Department of Labor and Industry, Fire and Panic Regulations

- B. Should any change in the Drawings and/or Specifications be required to conform to the codes, ordinances, regulations or laws mentioned above, the Owner's Representative shall be notified prior to the time of submitting bids.

1.11 NOTIFICATION

- A. Trades that have work connected with the heating, ventilating and air conditioning work and trades that do preparatory work for heating, ventilating and air conditioning shall be notified for installation requirements and scheduling.
- B. The Owner's Representative shall be informed of the installation schedule to allow sufficient time for inspection without any work delay.
- C. All work shall be coordinated to avoid cutting of work in place and interfering with other operations.
- D. In compliance with Act 38, contact individual companies to have utility locations marked in the field and to otherwise locate underground objects as may be necessary prior to the start of construction.
 - 1. Pennsylvania law requires three working days notice for the construction phase and ten working days in design stage. Call Pennsylvania One Call System, Inc. (1-800-242-1776, as of this writing).

1.12 CONTRACT DRAWINGS

- A. Contract Drawings are diagrammatic and indicate the relation of piping, ductwork, connections and equipment. The Drawings do not indicate all offsets, elbows and fittings that may be required. Therefore, the Contractor shall carefully investigate the structural and finish conditions affecting the work. The Contractor shall furnish all offsets, elbows, fittings, hangers and accessories as may be required to meet these conditions at no additional cost to the Owner.
- B. Do not scale the Drawings. The Contractor shall check conditions at the site for dimensions and sizes pertaining to the structure.
- C. Do not deviate from the Drawings without prior approval.

1.13 LINES, GRADES AND SURVEYS

- A. All necessary surveys, lines, grades and measurements are the responsibility of the Contractor desiring the information for the proper installation of his work. The Contractor is responsible for the proper installation of the work with respect to other Contractors.

- B. Grades, elevations and locations shown on the Drawings are approximate and the Contractor shall check all such information on the site before proceeding with the work.

1.14 WORKMANSHIP

- A. All equipment, piping, conduit, insulation, fixtures, etc. shall be installed meeting the accepted standards of the representative industry.
- B. All work to be performed shall be done by qualified mechanics. All mechanics in the employ of this Contractor on this project shall be skilled in the phases of the work to which they are used. The mechanic's affiliation with labor organizations shall be acceptable to all trades employed on the project.

1.15 SUBMITTAL PROCEDURES

- A. Transmit each submittal with an Owner's Representative's accepted form. Include one copy each for the Owner and the Owner's Representative in addition to copies required by the Contractor.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.
- C. Identify Project, Contractor, Sub-Contractor or Supplier; pertinent Drawing sheet and detail number and Specification Section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- E. Incomplete submittals shall not relieve the Contractor of providing a complete and functional system.
- F. Schedule submittals to expedite the Project. Coordinate submission of related items.
- G. Submittals by the Contractor must be in complete compliance with the Contract Documents unless exceptions are identified. Exceptions to the Contract Documents may only be made to improve the project. Exceptions cannot be taken which would provide an incomplete and/or nonfunctional system.
- H. Exceptions must be included in/on the submittal in a separate paragraph or drawing block located below the Contractor's stamp identified by the title "Exception to Contract Documents." Exceptions cannot be part of the standard Contractor's stamp.
- I. Provide space for Contractor and Owner's Representative review stamps.
- J. The Owner's Representative will return Shop Drawings with the following designations:
 - 1. Approved: Further submission not required.
 - 2. Approved as Noted: Corrections must be incorporated in final installation. Further submission not required unless specifically noted.

3. Noted: Placed in project files for information only.
4. Revise and Resubmit: Make necessary changes and resubmit prior to fabrication.
5. Not Approved: Does not meet project requirements. Resubmit in accordance with Contract Documents.

- K. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- L. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.16 SHOP DRAWINGS/PRODUCT DATA

- A. Submit manufacturer's installation instructions.
- B. Submit Shop Drawings and/or catalog cuts for all specified materials and equipment, piping layouts and ductwork layouts.
- C. Submit Shop Drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
- D. Mark dimensions and values in units to match those specified.
- E. Show equipment sizes and locations, by dimensions, of ducts, equipment and other items.
- F. Include wiring diagrams, hole location and sizes and other data that could affect work by other trades.
- G. Show manufacturer's names, trade names, catalog numbers, accessories, special features and rating data.
- H. Indicate required clearances for operating parts, for removal and for servicing.
- I. Show performance data, including fan and pump curves.
- J. Show sound power levels of all rotating equipment.
- K. Indicate efficiencies and air leakage rates for filters and filter housings.

1.17 SUBSTITUTIONS

- A. Any bidder wishing to substitute "or equal" equipment may request a substitution. Manufacturers which are submitted as substitutions for approved equal status are considered to have equipment of similar quality; however, the Contractor shall not assume that a piece of equipment by a manufacturer submitted as a "substitution" will be automatically accepted. Compliance with the Drawings and Specifications is still required. If the substituted material is considered to be unacceptable, the Contractor shall provide the equipment as originally specified.
- B. Substitutions are encouraged when there is significant cost savings or an improvement to project. Submit reasons for changes with any requests for substitution. All requests for

substitutions must be made within 30 days of contract award unless stated otherwise in the General Conditions.

- C. Bid alternates shall be clearly defined on the bid forms in order to be evaluated during the bidding process.
- D. By submitting an alternate or substitution, the Contractor automatically agrees to the following:
 - 1. The Owner shall be reimbursed by the Contractor for any additional costs incurred by the Owner's Representative to review the substituted materials, in accordance with the then current Owner's Representative's hourly rate.
 - 2. The Owner shall be reimbursed by the Contractor for any additional costs incurred by the Owner's Representative for field or office conferences caused by the substituted materials in accordance with the then current Owner's Representative's hourly rate.
 - 3. The consideration of alternates/substitutions does not obligate the Owner's Representative to accept same.
 - 4. In the event a brand is approved and substituted, it is the responsibility of the Contractor to so coordinate his substituted material into the original work at no extra cost to the Owner or any other Contractor.

1.18 CUTTING AND PATCHING

- A. In new construction, the Contractor shall give the General Contractor complete information as to size of openings required in floors and walls, etc., so that such openings may be provided as the project progresses. In existing construction, the Contractor shall do his own cutting and patching required for the installation of his work.
- B. If openings are omitted or are incorrect through failure of the Contractor to follow these instructions, the Contractor shall, at his own expense, engage the trade, which originally installed the work, to cut and patch to the satisfaction of the Owner's Representative.
- C. All cutting and patching of every nature required in connection with this Contract shall be done by the Contractor with mechanics experienced in their respective lines of work. All patching shall match adjacent finishes.
- D. All cutting in the building shall be done with great care so as not to leave an unsightly surface, which may not be concealed by plates, escutcheons or other normal concealing construction. If such unsightly conditions occur, the Contractor shall be required, at his own expense, to engage the General Contractor to replace the damaged materials with new materials.

1.19 CONCRETE AND MASONRY WORK

- A. Unless otherwise noted, all concrete bases, reinforcing, etc. and masonry work required to install the respective Contract Work shall be furnished and installed by the respective Contractor.
- B. The Contractor shall furnish all materials, labor, equipment and tools necessary to complete concrete work.

- C. Contractor shall provide minimum of four inch thick concrete bases under all floor mounted equipment.
- D. All concrete work shall comply with the requirements of the ACI Building Code (ACI 318), the ACI Detailing Manual (ACI 315) and the Specifications for Structural Concrete for Buildings (ACI 301).
- E. All reinforcing steel shall be manufactured from high strength billet steel conforming to ASTM Designation A-615, Grade 60. WWF shall comply with ASTM A-185.

1.20 MATERIALS

- A. All materials and equipment provided by this Contractor shall be new, without imperfections and blemishes and shall be protected from the elements prior to installation in building.
- B. All equipment shall be tested, listed and labeled by an approved authority (UL, AGA, ETL) and shall be installed in accordance with its listing. Installation instructions shall be available at the job site.
- C. All equipment subject to specific requirements of the Owner's insurance company (gas trains, etc.) shall meet the insurance companies' requirements.

1.21 METHODS

- A. The HVAC Contractor shall confer with all other Contractors and shall apply for detailed and specific information regarding the location of all equipment as the final location may differ from that indicated on the Drawings. Ductwork, piping or equipment improperly placed because of the HVAC Contractor's failure to obtain this information shall be relocated and reinstalled by the HVAC Contractor without additional expense to the Owner.
- B. Each Contractor, upon request of the Owner's Representative shall expedite the work of a specific area, section or part of the project to permit the installation of another part of the work.
- C. All ductwork, piping, accessories and equipment shall be installed in such a manner as to preserve access with sufficient space provided for proper operation and maintenance to any existing equipment or to any new equipment installed under this Specification or under other Specifications or Contracts for this building.
- D. This Contractor shall coordinate his work with that of other trades so that all work may be installed in the most direct manner and so that interference between piping, ducts, equipment, architectural or structural features will be avoided. In the case interference results, the Owner's Representative shall decide which work is to be relocated, regardless of which is first installed. Such relocation shall be at no additional cost to the Owner.
- E. All materials and equipment installed by the Contractor shall be firmly supported and secured to the building structure where required.
- F. All items of labor, material and equipment not specified in detail or shown on the Drawings but incidental to, or necessary for, the complete and proper installation and proper operation of the

work described herein or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Specifications or Drawings.

- G. The Contractor shall provide isolation valves and unions or flanges at all pieces of equipment and at all branch take-offs serving five or more pieces of equipment (whether indicated or not) to facilitate replacement or service of the equipment.
- H. All equipment shall be installed in accordance with the manufacturer's recommendations and installation instructions. The manufacturer's installation instructions shall be considered part of this Contract.

1.22 SCHEDULING OF WORK

- A. The Contractor shall attend all planning meetings, provide scheduling information and work with all trades to obtain a workable project schedule that meets the Owner's requirements.

1.23 PROTECTION

- A. Each Contractor shall effectively protect his work and materials with tarpaulins or heavy plastic material against dirt, water, chemicals, plaster or damage during the entire period of installation or until he is directed to remove the coverings by the Owner's Representative. Any damaged material must be removed and replaced by the Contractor without additional cost regardless of the cause of the damage. All openings in pipes, fittings, ductwork, etc. must be effectively sealed to exclude dirt, sand and other foreign substances.

1.24 PROTECTION OF OWNER'S EQUIPMENT

- A. The Contractor shall provide any temporary work required to protect the Owner's equipment and to contain the dust generated during construction. Any measures taken by the Contractor for the protection of equipment shall be installed to the satisfaction of the Owner or the Owner's Representative, which may include any and all provisions listed in DIVISION-1: GENERAL REQUIREMENTS and/or in accordance with the appropriate Technical Specifications for wood and plastics in DIVISION-6. An approved protection material is nylon reinforced flame retardant and anti-static Griffolyn T-55 ASFR 8 mil film. Telephone No. 1-800-231-6074.

1.25 RUBBISH REMOVAL AND CLEANUP

- A. Each Contractor is responsible for periodic removal of all rubbish resulting from his work. All surplus material, refuse, rubbish, etc., shall be removed from the job site at completion of Contract. The Owner's Representative must be satisfied with the removal and cleanup.

1.26 DELIVERING AND STORAGE OF MATERIALS AND EQUIPMENT

- A. Deliver accessories, small-unmarked parts, adhesives, and incidental items to the site in manufacturer's original, unopened, labeled containers.
- B. Store materials and equipment to prevent damage and injury. Store ferrous materials to prevent rusting. Store equipment to prevent staining and discoloring.

1.27 AS-BUILT DRAWINGS

- A. During construction, the Contractor shall maintain a record set of red lined installation prints. He shall record on these prints, all deviations from the Contract Drawings in pipe sizing, duct sizing, equipment, pipe or duct location, depth of pipe cover and details.
- B. At the completion of the work, the Contractor shall transfer this information onto one set of prints and onto computer generated construction documents and forward the as-built prints and an electronic copy to the Owner's Representative. Electronic copies of mechanical drawings, without title blocks, will be made available to the Contractor in AutoCAD as a .dwg file.

1.28 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Prior to completion of this project, the Contractor shall deliver to the Owner's Representative for approval three copies of an Operating and Maintenance Manual consisting of items outlined hereinafter.
- B. The purpose of this manual is to assist the Owner in routine operation, maintenance, servicing, troubleshooting and procurement of replacement parts. All information in the manual shall be as-built and only material pertinent to the project shall be included.
- C. The manual shall include the following:
 - 1. Manuals shall be bound, 8-1/2 x 11 inch text pages and set in three-ring binders with durable covers.
 - 2. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of project and subject matter of binder when multiple binders are required. All subject matter shall be in typewritten format.
 - 3. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab labeling clearly printed under reinforced laminated plastic tabs.
 - 4. Contents: Prepare a Table of Contents for each volume with product or system description identified, type on white paper.
 - 5. Part 1: Directory, listing names, addresses and telephone numbers of Owner's Representative, Contractor, Sub-Contractors and major equipment suppliers.
 - 6. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses and telephone numbers of Sub-Contractors and suppliers. Operating and start-up instructions shall be written in a concise step-by-step manner. Maintenance instructions shall include maintenance schedules, procedures, adjustments and troubleshooting techniques. All non-pertinent information in the manuals shall be either eliminated or crossed out in a neat and thorough manner. Identify the following:
 - a. List of equipment
 - b. Parts list for each component

- c. Operating instructions
 - d. Maintenance instructions for equipment and systems
- 7. Part 3: Project documents and certificates, including the following:
 - a. Corrected shop drawings and product data
 - b. Control wiring diagrams
 - c. Certificates
 - d. Photocopies of warranties
 - e. Valve tag list
- 8. Submit one copy of completed volumes in final form 30 days prior to final inspection. This copy will be returned after final inspection, with the Owner's Representative's comments. Revise content of documents as required prior to final submittal.
- 9. Submit final volumes revised, within ten days after Owner's review.

1.29 IDENTIFICATION OF MATERIALS AND EQUIPMENT

- A. Label concealed and exposed piping not more than 25 feet on centers and adjacent to all valves and equipment for easy identification. This does not apply to control compressed air, underground pipe or pipe located within walls. Show flow arrows and medium conveyed in the pipe. Labels shall conform to ANSI A13.1 for color, letter size and marker length.
- B. Identify starters, fans, air conditioning units and other equipment with permanent plates giving name of item, manufacturer's name and operating characteristics.
- C. Show, for items with moving parts, complete information regarding lubricating materials and frequency of lubrication.
- D. Valve tags shall be provided on all valves. Tags shall be two inches in diameter, brass, Style 300-BL as manufactured by Seton Name Plate Corporation. Each tag shall be securely fastened to the valve stem with brass "S" hooks. Additional tags shall be fastened on ceiling tiles or access doors to further identify concealed valves.
- E. Each tag shall be stamped showing the system name, valve identification number, function and position (i.e., N.O., N.C., Balancing Two-Way, Modulating, etc.).
- F. The Contractor shall provide a typewritten valve list segregated by systems, showing valve number, equipment served or system function and location in building by room and nearest column. The list should be on 8-1/2 x 11 inch paper bound in plastic binder and three copies submitted to the Owner or the Owner's Representative for approval and after approval, six copies for final information.

1.30 PAINTING

- A. Where factory finishes are provided and no additional field painting is specified; all marred or damaged surfaces shall be touched up or refinished to a smooth and uniform finish.

- B. All exposed ferrous metalwork, pipe, supports, hangers, insulation, exterior equipment including aluminum and other surfaces not factory painted shall be painted with one prime and two finish coats. Paint, surface preparation and application shall be as specified in Section: PAINTING. Colors shall match existing work or shall be as selected by the Owner's Representative.

1.31 LAWS, ORDINANCES AND REGULATIONS

- A. All systems in all and/or part shall conform to all pertinent laws, ordinances and regulations of ALL bodies having jurisdiction, at all governing levels. In case of conflict between governing levels, the more stringent law shall apply. As a minimum, all work shall comply with BOCA Mechanical Code, NFPA, OSHA, SMACNA and Pennsylvania Labor & Industry requirements.

- 1.32 The Contractor shall pay all fees, prepare and submit all utility applications and obtain and pay for all permits and inspections required for his work including L&I boiler room plans and L&I inspections and approvals.

1.33 BUILDING EXPANSION JOINTS AND FIRE RATED ASSEMBLIES

- A. Provide expansion joints in ductwork and piping where they cross building expansion joints.
- B. Provide fire dampers in all penetrations through fire rated floors, walls and partitions and provide ceiling radiation dampers in penetrations through fire rated ceiling assemblies as required to maintain the necessary fire rating and/or UL rating of the assembly.
- C. Meet all requirements of Underwriter's Laboratories and all applicable codes for maintaining the integrity of all fire rated assemblies.
- D. Seal space around ducts, pipes or conduits with approved fireproof material where they pass through fire rated assemblies.

1.34 ACCESS DOORS

- A. The Contractor shall provide access panels/access doors for access to dampers, valves, controllers or any other equipment or component requiring access for maintenance, adjustment or service wherever these items are concealed in building walls, partitions or ceilings. Frames shall be anchored in walls, partitions or ceilings and shall be set true to lines of the building and flush with the finished surfaces. Access panels/access doors shall be as specified in the General Construction Sections of the Specifications.

1.35 FASTENING, SUPPORTS AND HANGERS

- A. All fastenings, supports, hangers, miscellaneous steel, clamps and anchors shall be of the type made for the specific purpose for which they are to be used. Toggle bolts or machine bolt fastenings shall be used for hollow tile, terra cotta or lath construction. Machine screws shall be used for structural steel fastenings. Lead expansion shield and machine screws or lag screws shall be used for solid masonry fastening. Lag screws shall be used for wood fastening. All equipment, piping and ductwork shall be rigidly and firmly installed to prevent swaying, vibrating or sagging by malleable or wrought steel hangers of standard design, pipe clamps or

fabricated steel supports of approved design. Hangers of horizontal piping runs shall be adjustable clevis-type. Perforated strap iron hangers and caddy clips are not permissible.

1.36 SOUND PARTITIONS

- A. Contractor shall be responsible to identify all sound partitions indicated on the architectural plans. Contractor shall seal all penetrations through the wall to maintain the sound absorption integrity of the partition.

1.37 CONCRETE INSERTS

- A. The HVAC Contractor shall provide and install concrete inserts of an approved carbon steel wedge-type for all hangers. Where two or more parallel pipes are installed continuous inserts may be used. Where required to distribute the load on the inserts, a piece of reinforcing steel of sufficient length shall be passed through the insert. Each insert shall include a knockout piece. Inserts shall have a minimum safety factor of five.

1.38 SLEEVES

- A. The HVAC Contractor shall provide and install sleeves where required to protect equipment or facilities in the installation. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise required.
- B. Sleeves in bearing and masonry walls, floors and partitions shall be of standard weight steel pipe, finished with smooth edges. For other masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 U.S.G. galvanized iron.
- C. All sleeves shall be properly installed and securely cemented in place.
- D. Floor sleeves shall extend one inch above the finished floor. Space between floor sleeves and passing conduit shall be caulked with an approved graphite packing or waterproof caulking compound.
- E. Where pipes pass through waterproofed floors or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
- F. Where pipes, ducts or conduits pass through fire resisting portions of the structure, the annular space between the sleeve and the pipe, duct or conduit shall be filled with an approved fireproof material as required to maintain the fire rating of that portion of the structure. "Firestop Penetrator," or "Proseal Plug Devices" as manufactured by ProSet Systems (or approved equal) shall be used for piping and conduit.
- G. See architectural drawings for fire ratings of building components.

1.39 FIRE STOPPING

- A. The contractor shall be responsible to provide and install fire-stopping materials and/or systems where his work penetrates fire and/or smoke rated portions of the building and non-fire resistance-rated assemblies. All materials used shall be manufactured such that they are

intended to resist the spread of fire and the passage of smoke. This includes but is not limited to rated walls, floors, shafts, ceilings, and non-fire resistance-rated horizontal assemblies. All fire stopping materials used shall have a fire resistance rating equal to or greater than the rated assembly for which they are installed.

- B. For locations where the installed fire stopping material is exposed to normal view, the contractor shall conceal the material with chrome-plated escutcheon plates or other materials that have a flame-spread value of 25 or less and a smoke developed rating of 50 or less, as determined per ASTM E 84. The concealing device shall be approved by the owner's representative prior to installation. Provide shop drawings for each device.
- C. The contractor shall provide components/accessories for each fire-stopping system that are needed to install fill materials and to comply with all system performance requirements as recommended by the fire stopping material manufacturer. Accessories include but are not limited to: mineral wool insulation, ceramic fiber, sealants used to aid in the formation of the fire stopping materials, fire-rated formboard, joint fillers and sealers, collars and steel sleeves.
- D. Fire stopping materials and systems shall include, but are not limited to, the following: fire barrier caulk and sealants, intumescent caulk, intumescent putty, intumescent wrap strips, silicone foams and sealants, fire barrier composite sheets and cast-in-place fire barrier systems.
- E. Fire stopping materials and systems shall be as manufactured by 3M Fire Protection Products, Hilti Corporation, or ProSet Systems Inc.

1.40 ANCHOR BOLTS

- A. The Contractor shall provide and set in place, at the time of pouring of concrete foundations, all necessary anchor bolts as required for the equipment called for in these Specifications. Anchor bolts shall be of the hook-type, of proper size and length to suit the equipment. Anchor bolts shall be set in pipe sleeves of approximately twice the bolt diameter and one half the embedded length of the bolt. The Contractor shall assume full responsibility for proper coordination and placement of the bolts. Upon completion of equipment installation, pipe sleeves shall be caulked in accordance with Paragraph: "SLEEVES" in this Section of the Specifications.

1.41 WARRANTY

- A. The systems specified herein shall be guaranteed to be free from defects in workmanship and material under normal use and service for a period of one year (five years for all compressors) from date of substantial completion.
- B. If, within the aforementioned warranty period, any material specified herein is proven to be defective in any way, it shall be replaced or repaired at no additional cost to the Owner. Warranty shall include providing of all labor and materials necessary for repair or replacement of any defective components. The Contractor is responsible for costs of any services required by equipment suppliers that are not included in suppliers' warranties.
- C. The Contractor shall, after acceptance of the installation by the Owner or the Owner's Representative, provide any service incidental to the proper performance of the systems under the warranties outlined above for the time periods listed above.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 230501

SECTION 230502

SPECIAL HVAC REQUIREMENTS

PART 1 - GENERAL

- 1.1 Applicable requirements of the Contract Documents, preceding the Technical Specifications, apply to this Section. In the event of conflict between the Specifications, the most stringent shall apply.
- 1.2 SCOPE.
- A. The work covered by and included in these Specifications consists of the furnishing of all materials, all equipment, labor, tools and supervision and performing all operations necessary for the proper and complete execution of the Heating, Ventilating and Air Conditioning work in strict accordance with the Specifications and the Drawings and subject to the terms and conditions of the Contract:
- 1.3 WORK IN THE EXISTING BUILDING.
- A. The HVAC Contractor shall be responsible for thoroughly surveying the existing building to determine the extent and cost of installing new equipment and materials in the existing building.
- B. All new equipment and materials shall be installed in the existing building as herein specified.
- C. All Contractors, before starting any cutting of the present building, must first obtain approval from the Owner's Representative on the site before cutting at each location. This Contractor shall provide any temporary work required to retain the dust generated by his work as may be directed by the Owner's Representative. All dust found, which has escaped the area of cutting, shall be properly removed by the Contractor without additional cost to the Owner.
- D. All openings cut into the exterior of the existing structure must be completely sealed and waterproofed before leaving the job site each day. This shall be done by the Contractor responsible for the cutting.
- E. Contractor should not assume utilities can be installed as shown. Drawings are diagrammatic and utilities may need to shift to accommodate existing conditions. In some cases equivalent duct sizes may be required to be used or relocating and existing utility may expedite or simplify construction. It is believed that in general the project can be constructed with utilities in approximately the locations as shown.
- F. Construction phasing could require installation of some temporary feeds and system shutdowns to accommodate construction.

1.4 INTERRUPTION OF SERVICES.

- A. The Contractor shall schedule his work to avoid any interruption of any utility services to the operation areas of the building during normal working hours. Interruption of services shall be done during off hours at no additional cost to the Owner.
- B. The Contractor shall notify the Owner and the Owner's Representative at least three days prior to any interruption of services. The scheduling of all interruptions shall be approved by the Owner.

1.5 DEMOLITION.

- A. The Contractor shall perform all demolition work as indicated on the Drawings and as described below as part of this Contract:
- B. The Contractor shall cut and patch as required to perform the demolition work. All openings created must be repaired to match existing conditions.
- C. All cutting and patching shall be performed by mechanics experienced in their respective line of work. If the Owner's Representative is not satisfied with quality of work, the Contractor shall be required, at his own expense, to engage the General Contractor to replace damaged materials with new materials.
- D. The Owner shall be given the opportunity to retain ownership of all removed materials and equipment. All such items shall be carefully handled and protected and shall be stored by this Contractor at the site as directed by the Owner. Any such materials and equipment not desired by the Owner shall become the property of the Contractor and shall be removed promptly from the project site. Disposal shall be in accordance with the regulations of the authorities at the disposal site.
- E. If the Contractor encounters or suspects hazardous or toxic material, the Contractor shall advise the Owner immediately. The work in the affected area shall not be resumed by the Contractor until the hazardous material has been removed or rendered harmless by the Owner.

1.6 OWNER FURNISHED EQUIPMENT.

- A. The Contractor shall install all equipment designated on the drawings to be Owner furnished.
- B. The Contractor shall be responsible to receive, store and enforce warranty on Owner furnished equipment as if it were originally furnished by the Contractor.
- C. The Contractor shall thoroughly inspect Owner furnished equipment upon receipt. The Contractor shall have 24 hours after receipt to note any damage to Owner furnished equipment. After that time, the Contractor shall be fully responsible for the condition of the Owner furnished equipment.

1.7 AUXILIARY DRAIN PANS.

- A. Provide an auxiliary drain pan below all equipment that is able to generate condensate. Drain pans shall be custom built to fit below unit and shall be constructed of 18 gauge sheet metal with welded ends as required to form a water-tight drain pan. Drain pan shall be a minimum of 1-1/2

inch deep. Drain pan shall be supported from the unit supports or shall be supported independently from the building structure.

- B. Water sensor: Contractor shall provide a water sensor in the auxiliary drain pan that will shut-down the unit and sound an alarm if water is detected in the pan. Sensor shall be Model JMP series with 'L' mounting bracket as manufactured by Kele or EZ Trap Model EZT-226 with EZT-113B or equal. Install in accordance with manufacturer's instructions.

1.8 COORDINATION DRAWINGS.

- A. In addition to the required manufacturer and "field" Shop Drawing submittals, all trades shall participate in the preparation of composite coordination drawings.
- B. Each trade shall show planned mechanical/plumbing work on minimum 3/8" = 1'-0" layout drawings (plan & section views) and participate in a minimum of 15 coordination meetings initiated by the General Contractor. Meetings shall include installers of plumbing, HVAC, fire protection, insulation, and electrical work.
- C. Under the General Contractor's supervision, the ductwork contractor shall prepare composite utility/service drawings which overlay all trades' work.
- D. The completed drawings shall show interfaces of ductwork, electrical conduit and cable trays, fire protection and plumbing lines sized 1-1/2 inch and above (diameters include exterior insulation). All drain lines shall be illustrated regardless of size to ensure adequate "fall" is achievable in concealed cavities
- E. Prepare drawings to show clearances for installing and maintaining insulation, breaking down equipment, pulling tubes, replacing filters and motors, valve stem movement and similar requirements.
- F. Provide details and sections as needed to conclusively show successful coordination and integration of work.
- G. Access door requirements to satisfy the needs of Paragraph E shall be located.
- H. Professional will not supervise coordination which is the exclusive responsibility of the Contractor.

PART 2 – PRODCUTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 230502

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes basic requirements for factory- and field-installed motors.

1.2 DEFINITIONS

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.3 SUBMITTALS

- A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.
- B. Qualification Data: For testing agency.
- C. Source quality-control test reports.
- D. Training Reports: Submit reports on training documenting dates and attendance.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in PART 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Follow manufacturer's instructions for storage and handling of motors.

1.6 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.
 - c. Reduced-voltage controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

- A. Written manufacturer's warranty covering parts and labor for a period of one year from substantial completion, or eighteen months from shipment, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Motors:
 - a. Baldor.
 - b. General Electric.
 - c. Lincoln Motors.
 - d. Marathon.
 - e. Reliance.
 - f. U.S. Motors.

2.2 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory- and field-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for motor are specified in another Section.
 - 2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.3 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase.

- B. Motors Smaller Than 1/2 HP: Single phase.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected. 208V motors shall be rated for continuous operation at 200V.
- E. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open drip proof.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium, as defined in NEMA MG 1.
- C. Stator: Copper windings, unless otherwise indicated.
 - 1. Multispeed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Motors shall be inverter-duty. Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.
 2. Temperature Rise: Matched to rating for Class B insulation.
 3. Insulation: Class F.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 5. Provide Aegis shaft grounding rings.
- C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.
1. Finish: Chemical-resistant paint over corrosion-resistant primer.
- D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:
1. Measure winding resistance.
 2. Read no-load current and speed at rated voltage and frequency.
 3. Measure locked rotor current at rated frequency.
 4. Perform high-potential test.

2.6 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split-phase start, capacitor run.
 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal- protection device shall automatically reset when motor temperature returns to normal range.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- D. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory- and field-installed motors. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace them with new units and retest.

3.2 CLEANING

- A. Comply with applicable requirements in Division 23 Section "HVAC Equipment Cleaning."

3.3 CONTRACTOR STARTUP AND REPORTING

- A. Prepare for acceptance tests.
 1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
 2. Verify bearing lubrication.
 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 4. Test interlocks and control and safety features for proper operation.
 5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory- and field-installed motors. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace them with new units and retest.

3.4 DEMONSTRATION AND COMMISSIONING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain field-installed motors. Refer to Division 01 Section "Demonstration and Training."
 1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining chillers. The training will occur after the startup report has been provided to the owner and the trainer will provide two (2) Installation and Operations manuals for the use of the owners personnel during training.
 2. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data." All required and recommended maintenance will be reviewed as well as operational trouble shooting. If the IOM does not include a written trouble shooting guide one will be provided.
 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- B. Demonstrate proper operation of equipment to commissioning agent or designated owners

personnel. The scope of the demonstration will include functional performance requirements under both local and building automation control, as well as any commissioning requirements in Division 01 or 23.

END OF SECTION 230513

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Equipment supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.

- C. Delegated-Design Submittal: For trapeze hangers 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. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U- bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon- steel shapes.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads

being supported. Weld steel according to AWS D1.1/D1.1M.

- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop

painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting", Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel- pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36,

- with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 5. C-Clamps (MSS Type 23): For structural shapes.
 6. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 7. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 8. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids

- with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1- 1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

**SECTION 230548
VIBRATION CONTROLS FOR HVAC**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Pipe-riser resilient support.
 - 5. Resilient pipe guides.
 - 6. Air-spring isolators.
 - 7. Restrained-air-spring isolators.
 - 8. Elastomeric hangers.
 - 9. Post-installed concrete anchors.
 - 10. Concrete inserts.
 - 11. Vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Include load rating for each wind-force-restraint fitting and assembly.
 - 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic restraint component.
 - 4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by ICC-ES product listing, UL product listing, FM Approvals, or an agency acceptable to authorities having jurisdiction.
 - 5. Annotate to indicate application of each product submitted and compliance with requirements.
 - 6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. Product Listing, Preapproval, and Evaluation Documentation: By an evaluation service member of ICC-ES, UL, FM Approvals, or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
2. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Air-Spring Isolator Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-spring isolators and restrained-air-spring isolators to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Management Corp.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
5. Surface Pattern: Smooth, ribbed, or waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth, ribbed, or waffle pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Management Corp.
2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil- and water-resistant neoprene rubber, silicone rubber, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Management Corp.
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 PIPE-RISER RESILIENT SUPPORT

- A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch Thick Neoprene:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Management Corp.
 2. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 3. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.5 RESILIENT PIPE GUIDES

- A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch- Thick Neoprene.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Management Corp.
 2. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.6 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Management Corp.
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.7 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Drilled-in and capsule anchor system containing PVC 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 E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 1, ASCE/SEI 7-10, Ch. 13, ASCE/SEI 7-16, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.

1. Undercut expansion anchors are permitted.

2.8 CONCRETE INSERTS

A. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC408 testing.

B. Comply with ANSI/MSS SP-58.

2.9 RESTRAINED ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
 2. Thybar Corporation.
 3. Vibration Management Corp.
- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.
- C. Upper Frame: To provide continuous support for equipment and to be captive to resiliently resist seismic forces.
- D. Lower Support Assembly: To be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. Lower support assembly to have a means for attaching to building structure and a wood nailer for attaching roof materials, and to be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Mount adjustable, restrained-spring isolators on elastomeric vibration isolation pads and provide access ports, for level adjustment, with removable waterproof covers at all isolator locations. Locate isolators so they are accessible for adjustment at any time during the life of the installation without interfering with integrity of roof.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL DEVICES

- A. Provide vibration-control devices for the following systems.
 - 1. DOAS – 1 & 2.
 - 2. VRFHP-1,2
 - 3. EF-1
 - 4. SSAC-1
 - 5. All VRF AH units
- B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- D. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. 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.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Mechanical Anchor Bolts:
 - 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 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-Type Anchor Bolts: 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-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ADJUSTING

- A. Adjust isolators after system is at operating weight.

- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. 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 post connection 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 no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
 - 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.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 230548

**SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.
7. Sample Schedules.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label. An electronic copy and hard copy will be provided to THE OWNER before preliminary acceptance. Furnish extra copies (in addition to mounted copies) for Maintenance.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals. An electronic copy and hard copy will be provided to the Owner before preliminary acceptance. Furnish extra copies (in addition to mounted copies) for Maintenance.

1.3 QUALITY ASSURANCE

- A. Follow manufacturer's recommended installation procedures.
- B. As applicable, comply with ASME A13.1 "Scheme for the Identification of Piping System."

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a dry and secure area on-site and protect against dirt and moisture damage
- B. Do not apply or install damaged materials.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces

where devices are to be applied.

- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.6 WARRANTY

- A. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of substantial completion, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Seton
 - 2. Brady
 - 3. Best
 - 4. Milwaukee

2.2 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch or Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Letter Size: 4 by 2 inch. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Fasteners: Stainless-steel self-tapping screws.
 - 4. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data. See Sample Equipment Schedule at end of this Specification.

2.3 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.

- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F .
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch .
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches , 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions. Coordinate with Architect and Owner for specific warning label information to be included.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction. Do not provide labels for bare pipes conveying fluids at temperatures of 125 °F or higher.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F .
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.

- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch or Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal- operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data. See Sample Valve Tag Schedule at the end of this Specification.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 4 by 7 inches.
 - 2. Fasteners: Reinforced grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.
- B. Identification for piping, duct or equipment in sales floor should be installed on surfaces away from direct view of customers.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section " Painting"
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Refrigerant Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts..
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Refrigerant: 2 inches, round..
 - b. Gas: 2 inches, round..
 - 2. Valve-Tag Color:
 - a. Refrigerant: Natural.

- b. Gas: Natural.
- 3. Letter Color:
 - a. Refrigerant: Black.
 - b. Gas: Black.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 SAMPLE SCHEDULES

- A. The following tables are examples of schedules required to be submitted by the Contractor. Examples of the kinds of information to be included are in the first row in these tables.

EQUIPMENT LABEL SCHEDULE

EQUIPMENT IDENTIFICATION	EQUIPMENT LOCATION	SPECIFICATION SECTION		REMARKS
		NUMBER	TITLE	
AHU-xx	MECHANICAL ROOM M-xxx	23 xx xx		MODULAR INDOOR AIR- HANDLING

3.8 CLEANING

- A. Follow manufacturer's instructions for surface preparation prior to application or installation.
- B. Follow Manufacturer's instructions for cleaning labels and tags.

END OF SECTION 230553

**SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use

tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.

- a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat- recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full- heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
 1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.
 3. Airflow.
 4. Air pressure drop.
 5. Refrigerant suction pressure and temperature.

3.10 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.

3.11 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.

- b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
- 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
- 14. Notes to explain why certain final data in the body of reports vary from indicated values.
- 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

**SECTION 230700
HVAC INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
 - c. Polyisocyanurate.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied jackets.
10. Identification
11. Tapes.
12. Securements.
13. Corner angles.

1.2 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal Resistivity: "R-values" represent the reciprocal of thermal conductivity (K-value). Thermal conductivity is the rate of heat flow through a homogeneous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.
- E. Density: Is expressed in lb/cu. ft.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thermal resistivity (R- value), thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail insulation application at pipe expansion joints for each type of insulation.
 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 5. Detail application of field-applied jackets.
 6. Detail application of Identification
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
 9. Detail outdoor duct insulation installation.
- C. Samples: For each type of insulation jacket, and identification indicated. Identify each Sample, describing product and intended use.
1. Sample Sizes:
 - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - d. Sheet Jacket Materials: 12 inches square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Material Test Reports: From a qualified testing agency acceptable to the authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Except where indicated otherwise, insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by UL or another testing and inspecting agency acceptable to the authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 2. Insulation Installed Outdoors:
 - a. Flame-Spread Index: 75 or less.
 - b. Smoke-Developed Index: 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packages and containers with seals unbroken and bearing manufacturer's original labels, including manufacturer's name, product name, and directions for storing, handling, and use.
- B. Store materials in a clean, dry, fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
 - 1. Remove damaged or wet insulation from Project site.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for 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.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 WARRANTY

- A. Provide warranty on materials and labor for 60 months starting from date of delivery, or one year from date of Preliminary Acceptance or Substantial Completion, whichever is longer.

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. Flexible Elastomeric Insulation:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
 - 2. Mineral-Fiber Blanket Insulation:

- a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Owens Corning; All-Service Duct Wrap.
3. Mineral-Fiber Board Insulation:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
4. Mineral-Fiber, Preformed Pipe Insulation:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Owens Corning; Fiberglas Pipe Insulation.
5. Mineral-Fiber, Pipe and Tank Insulation:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
6. Mineral-Fiber Insulating Cement:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.
8. Flexible Elastomeric and Polyolefin Adhesive:
 - a. Aeroflex USA Inc.; AeroSeal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
9. Mineral-Fiber Adhesive:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.

10. ASJ Adhesive, and FSK Adhesive:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
11. PVC Jacket Adhesive:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. Speedline Corporation; Speedline Vinyl Adhesive.
12. Vapor-Barrier Mastic:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Vamasco Corporation; 749.
13. Lagging Adhesives:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Vamasco Corporation; 136.
14. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Pittsburgh Corning Corporation; Pittseal 444.
 - d. Vamasco Corporation; 750.
15. Metal Jacket Flashing Sealants:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Vamasco Corporation; 750.
16. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 - a. Childers Products, Division of ITW; CP-76.
17. PVC Jacket:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
18. Metal Jacket:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.

- b. IDC Corporation.
 - c. RPR Products, Inc.; Insul-Mate.
19. Identification:
- a. Seton.
 - b. Brady.
 - c. Best.
 - d. Milwaukee.
20. ASJ Tape:
- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
21. FSK Tape:
- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
22. PVC Tape:
- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
23. Bands:
- a. Childers Products; Bands.
 - b. IDC Corporation.
 - c. RPR Products, Inc.; Bands.
24. Insulation Pins and Hangers:
- a. AGM Industries, Inc.; CWP-1.
 - b. GEMCO; Cupped Head Weld Pin.
 - c. Midwest Fasteners, Inc.; Cupped Head.
 - d. Nelson Stud Welding; CHP
25. Wire:
- a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.2 INSULATION MATERIALS

- A. Comply with requirements in PART 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Preformed Pipe Insulation:
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4 ADHESIVES

- A. Adhesives, General: All adhesives and mastics installed within the building envelope shall be shown to comply either with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda, or with the VOC limits established in South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 1. Aerosol adhesives shall comply with Green Seal Standard for Commercial Adhesives GS-36 (2000).

- B. Compatibility: Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
 - C. Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - F. ASJ Adhesive, and FSK Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - G. PVC Jacket Adhesive: Compatible with PVC jacket.
 - H. Mastics: Comply with MIL-C-19565C, Type II. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 1. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - a. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 permats 43-mildry film thickness.
 - b. Service Temperature Range: Minus 20 to plus 180 deg F
 - c. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - d. Color: White.
- 2.5 Lagging Adhesives: Comply with MIL-A-3316C Class I, Grade A. Materials shall be compatible with insulation materials, jackets, and substrates.
- a. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
 - b. Service Temperature Range: Minus 50 to plus 180 deg F.
 - c. Color: White.
- 2.6 SEALANTS
- A. Sealants, General: All sealants installed within the building envelope shall be shown to comply either with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda, or with the VOC limits established in South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - B. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 4. Color: White or gray.
 - C. Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F
4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 JACKETS

A. Factory-Applied Jackets: Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I..
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

B. Field-Applied Jackets: Comply with ASTM C 921, Type I, unless otherwise indicated. Field-applied jackets shall be provided on all piping below 8 ft. height.

1. PVC Jackets: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

- a. Adhesive: As recommended by jacket material manufacturer.
- b. Color: White.
- c. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - 1) Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- d. Factory-fabricated tank heads and tank side panels.

2. Metal Jackets:

- a. Stainless-Steel Jackets: ASTM A 167 or ASTM A 240.
 - 1) Sheet and roll stock ready for shop or field sizing.
 - 2) Material, finish, and thickness are indicated in field-applied jacket schedules.
 - 3) Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - 4) Moisture Barrier for Outdoor Applications: 2.5-mil-thick Polysurlyn.
 - 5) Factory-Fabricated Fitting Covers: Fabricated from the same material, finish, and thickness as jacket. Provide factory-fabricated covers for preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows; tee covers; flange and union covers; end caps; beveled collars; and valve covers. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

b. Aluminum Jackets: Comply with ASTM B 209, Alloy 3003, Temper H-14.

- 1) Sheet and roll stock ready for shop or field sizing.
- 2) Finish and thickness are indicated in field-applied jacket schedule.
- 3) Moisture Barrier for Indoor Applications: 3-mil thick Polysurlyn.
- 4) Moisture Barrier for Outdoor Applications: 3-mil thick Polysurlyn.
- 5) Factory-Fabricated Fitting Covers: Fabricated from the same material, finish, and thickness as jacket. Provide factory-fabricated covers for preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows; tee covers; flange and union covers; end caps; beveled collars; and valve covers. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 IDENTIFICATION

A. General: Products specified are 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 listed application, selection is Installer's option but provide single selection for each product category.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Seton.
2. Brady.
3. Best.
4. Milwaukee.

C. Snap-On Plastic Pipe Markers: Manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers.

1. Lettering: Use piping system terms as indicated and abbreviate only as necessary for each application length.
2. Arrows: Either integrally with piping system service lettering (to accommodate both directions), or as separate unit, on each pipe marker to indicate direction of flow.

D. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same name are indicated, identify individual system number as well as service.

E. Color Coding:	<u>Background</u>	<u>Lettering</u>
1. Domestic Cold Water	White	Black
2. Domestic Hot Water/ Hot Water Return	Blue	White
3. Non Potable Water/ Makeup Water	Purple	White
4. Storm Water	Grey	White
5. Air Conditioning Condensate	Grey	White
6. Refrigerant Suction/ Hot Gas	Clear	Black
7. Natural Gas	Yellow	Black
8. Fire Protection	Red	White

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Width: 2 inches.
 2. Thickness: 6 mils.
 3. Adhesion: 64 ounces force/inch in width.
 4. Elongation: 500 percent.
 5. Tensile Strength: 18 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.020-inch thick, 3/4-inch wide with wing or closed seal.
 2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following:
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
 - 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized- steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 - 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
 - D. Wire: 0.062-inch soft-annealed, stainless steel.
- 2.11 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing, if any. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless- steel surfaces, use demineralized water.

3.3 INSTALLATION – GENERAL

- A. Install insulation materials, accessories, and finishes according to the manufacturer's written instructions with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Keep insulation materials dry during application and finishing.
- E. Install insulation with least number of joints practical.
- F. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install multiple layers of insulation with longitudinal and end seams staggered.
- I. Install vapor barriers on insulated pipes, ductwork, and equipment having surface operating temperatures below 60 deg F.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor

- legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - b. Exception: Do not staple longitudinal laps on insulation applied to piping systems with a surface temperature at or below 35 deg F.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
 6. At penetrations in jackets for thermometers, and pressure gages, fill and seal voids with vapor barrier coating.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof

penetrations.

1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions in accordance with requirements of approved and tested assembly indicated. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated.
 - a. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - b. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
 2. Pipe: Install insulation continuously through floor penetrations.

3.5 PIPE INSULATION INSTALLATION – GENERAL

- A. General: Requirements in this article apply to all insulation materials, unless more specific requirements are indicated for individual pipe insulation types.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Pipe Elbows: Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Tee Fittings: Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Valves: Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Strainers: Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Fittings and Unions: Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated on Drawings. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two- part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with

outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation

facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor- discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where Stainless Steel, or Aluminum, jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 LABELING AND IDENTIFYING INSTALLATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 1. Plastic markers with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.
 - a. Fasten markers on pipes smaller than 6-inch diameter by one of following methods:
 - 1) Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2) Adhesive lap joint in pipe marker overlap.
 - 3) Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4) Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide, lapped 1-1/2 inches minimum at both ends of pipe marker, and covering full circumference of pipe.
 - b. Fasten markers on pipes 6-inch and larger diameter by one of following methods:
 - 1) Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2) Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1- 1/2-inches wide, lapped 3 inches minimum at both ends of pipe marker, and covering full circumference of pipe.

- 3) Strapped to pipe (or insulation) with manufacturer's standard stainless steel bands.
2. Locate pipe markers and color bands as follows wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non- concealed locations.
 - a. Near each valve and control device.
 - b. Near each branch connection, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - c. Near penetrations through walls, floors, ceilings, or enter non-accessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at a maximum of 50-feet o.c. along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the Article "Duct Insulation Schedule, General".
 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment requiring insulation for this project. For large equipment, remove only a portion adequate to determine compliance.
 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field- applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the Article "Piping Insulation Schedule, General".
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Architect may reject all work if sample work is found to be defective.

3.11 DUCT INSULATION PERFORMANCE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, supply and outdoor air.
 2. Indoor, concealed return located in non-conditioned space.
 3. Indoor, return located in non-conditioned space.

4. Indoor, kitchen hood exhaust.
5. Indoor, exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Vibration-control devices.
4. Factory-insulated access panels and doors.

3.12 DUCT AND PLENUM INSULATION SCHEDULE

A. INSULATION APPLICATION SCHEDULE

1. General: Abbreviations used in the following schedules include:
 - a. Field-Applied Jackets: P - PVC, K - Foil and Paper, A - Aluminum, SS - Stainless Steel.

B. Indoor duct insulation shall be as indicated in the schedule below.

C. DUCT SYSTEMS INSULATION SCHEDULE

DUCT LOCATION	INSULATION MATERIAL	INSTALLED R-VALUE (H·FT ² ·DEG F/BTU)
Concealed Supply and Return Ductwork	MINERAL FIBER BLANKET	6.0
Supply and Return Ductwork in unconditioned spaces	MINERAL FIBER BOARD	12.0

3.13 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 PIPING INSULATION SCHEDULE

A. Abbreviations used in the following schedule include:

1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A - Aluminum, SS - Stainless Steel.
2. Pipe Sizes: NPS - Nominal Pipe Size.

B. Minimum HVAC Pipe Insulation Thickness Table :

	FLUID TEMPERATURE RANGE (DEG F)	INSULATION CONDUCTIVITY BTU-IN/(HR-FT ² -F)	PIPE SIZE AND INSULATION THICKNESS (INCHES) (Note 4)				
Indoor Condensate Drains (Note 1, 2)	40-60	0.21 – 0.27	0.5	0.5	1.0	1.0	1.0
Refrigerant (Note 1)	Less than 40	0.20 – 0.26	0.5	1.0	1.0	1.0	1.5

NOTE 1: (P), (A), OR (SS) FIELD-APPLIED JACKET ON OUTDOOR INSTALLATIONS,
EXPOSED AND CONCEALED.

NOTE 2: VAPOR BARRIER REQUIRED.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material for all piping below 8 ft. height. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Provide identification for all piping.
- C. Piping, Exposed:
 1. PVC, White – below 8 ft. height: 20 mils thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches
 1. Stainless Steel, Type 304, Smooth 2B Finish: 0.020 inch thick.
 2. Aluminum, Alloy 3003, Temper H-14, Smooth Finish: 0.020 inch thick.
- C. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 1. Stainless Steel, Type 304, Smooth Finish: 0.020 inch thick.
 2. Aluminum, Alloy 3003, Temper H-14, Smooth Finish: 0.020 inch thick.

D. Piping, Exposed

1. Stainless Steel, Type 304 Smooth 2B Finish 0.016 inch thick.

END OF SECTION 230700

SECTION 23 09 01
HVAC SEQUENCES OF OPERATION

1. GENERAL:
 - a. Coordinate building occupied periods and desired occupied and unoccupied temperature setpoints with the Owner's Representative.
2. EF-1:
 - a. Fan shall run when the building is scheduled to be occupied.
 - b. Provide time clock mounted on equipment platform for fan operation
3. EWH-1,2,3:
 - a. Electric wall heaters shall be controlled by their own integral tamperproof thermostats. Initial setpoint shall be 70 degrees (Adjustable).
4. GUH-1:
 - a. Gas unit heaters shall be controlled by wall mounted thermostats. Initial setpoint shall be 70 degrees (Adjustable).
5. VRFAH Units:
 - a. System schedule shall be controlled by the VRF Central Controller.
 - b. System shall include occupied and unoccupied modes of operation. Supply fan shall run intermittently during both occupied and unoccupied modes and the heating and cooling cycles shall energize as required to meet the temperature setpoint (adjustable).
6. DOAS-1,2:
 - a. Systems schedule shall be controlled by time clock.
 - b. System shall include occupied and unoccupied modes of operation. Supply fan and exhaust fans shall run continuously and outside air damper shall be open during occupied mode and the system shall deliver neutral air (70 degrees adjustable). The system shall activate the heating or cooling cycles to satisfy the discharge temperature setting.
 - c. If the relative humidity exceeds the humidistat setpoint (adjustable) the cooling cycle shall be energized, and the hot gas reheat shall reheat the air to the discharge air setpoint until the relative humidity setpoint has been satisfied.
7. SSAH-1/SSAC-1:
 - a. Supply fan shall run intermittently, and the heating and cooling cycles shall energize as required to meet the temperature setpoint (adjustable).

END OF SECTION 230901

**SECTION 232300
REFRIGERANT PIPING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes refrigerant piping used for air-conditioning applications.

1.2 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
- C. Welding certificates.
- D. Field quality-control test reports.
 - 1. Submit written reports documenting the activities required to be performed in PART 3. These reports are to be submitted two weeks after the startup is completed.
- E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.4 DELIVERY STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.5 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.6 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Refrigerants:
 - a. Atofina Chemicals, Inc.
 - b. DuPont Company; Fluorochemicals Div.
 - c. Honeywell, Inc.; Genetron Refrigerants.
 - d. INEOS Fluor Americas LLC.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR or type K complying with ASTM B88 or ASTM B819.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8.
- E. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.

3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. End Connections: Socket, union, threaded, or flanged.
6. Maximum Opening Pressure: 0.50 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2- inch (16-GRC) conduit adapter, and 115-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.

3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: See Equipment Schedules
 6. Superheat: Adjustable.
 7. Reverse-flow option (for heat pump applications).
 8. End Connections; Socket, flare, or threaded union.
 9. Working Pressure Rating: 700 psig.
- H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig.
 5. Maximum Operating Temperature: 275 deg F.
- I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig.
 6. Maximum Operating Temperature: 275 deg F.
- J. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 240 deg F.
- K. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated charcoal.
 4. End Connections: Socket.

5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig.
7. Rated Flow: See equipment sizing
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig.
7. Rated Flow: See equipment sizing
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

M. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

N. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

O. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

- B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 REFRIGERANT PIPE SIZING:

- A. All refrigerant pipe sizing shall be the responsibility of the Contractor in accordance with the equipment manufacturer's recommendations.
- B. Pipe sizing shall be in accordance with the recommendations in the 2010 ASHRAE Handbook – Refrigeration, Chapter 2 – System Practices for Halocarbon Refrigerants.
- C. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 3-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.3 VALVE AND SPECIALTY APPLICATIONS

- A. Install packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install packed-angle valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe

safety-relief- valve discharge line to outside according to ASHRAE 15.

- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.4 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 23 Sections "Building Automation System (BAS)" and "Building Automation System (BAS) - Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and

specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal suction lines with a uniform slope downward to compressor.
 - 2. Install traps and double risers to entrain oil in vertical runs.
 - 3. Liquid lines may be installed level.
- P. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC."

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- D. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for Piping and Equipment."
- B. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- D. Support multifloor vertical runs at least at each floor.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount

- of soap and glycerin solution over joints.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.8 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 - 4. Charge system with a new filter-dryer core in charging line.

3.9 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal ducts for supply, return, outside, transfer and exhaust air-distribution systems in pressure classes from minus four (4)- inch wg to plus ten (10)-inch wg. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
 - 3. Duct Liner
- B. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
 - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 - 2. Joints: Joints include girth joints; branch and sub-branch intersections; so-called duct collar tap- ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Hanger and Support Design: Hangers and supports shall comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."

1.3 SUBMITTALS

- A. Shop Drawings: Drawn at a scale of not less than 1/4" = 1'-0". Show fabrication and installation details for metal ducts.
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Duct layout indicating sizes and pressure classes.
 - 3. Elevations of top and bottom of ducts.
 - 4. Dimensions of main duct runs from building grid lines.
 - 5. Fittings.
 - 6. Reinforcement and spacing.
 - 7. Seam and joint construction.
 - 8. Penetrations through fire-rated and other partitions.
 - 9. Equipment installation based on equipment being used on Project.
 - 10. Duct accessories, including access doors and panels.
 - 11. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- B. Delegated-Design Submittal:
 - 1. Spacing of hangers and supports.
 - 2. Design calculations: Calculations, including analysis data, signed and sealed by the

qualified professional engineer responsible for their preparation for selecting hangers and supports.

- C. Coordination Drawings: Reflected ceiling plans and BIM model, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Other systems installed in same space as ducts.
 - 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 - 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be stored in a designated area and protected from inclement weather.
- B. All materials shall be secured so as not to be a hazard during the construction process.
- C. Store ductwork with tight-fitting seals on open ends to ensure ductwork is free of all dirt, debris and moisture during the installation process.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

- D. Stainless Steel: ASTM A 480/A 480M, Type 304 & 316.
- E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
- H. Insulated Flexible Ducts: Flexible ducts wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.

2.2 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes combinations of open-weave fabric strips and mastics.
- B. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- C. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- D. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.3 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: All-thread rods used in pool areas, pool equipment rooms, and pool supporting spaces shall be aluminum if the ducts are aluminum and stainless steel if the ducts are stainless steel.
 - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
 - 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.

3. Supports for Aluminum Ducts: Aluminum support materials..

2.4 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
 1. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.5 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Manufacturers: applicable to factory-fabricated duct and fittings:
- B. Subject to compliance with requirements, provide products by one of the following manufacturers:
 1. Ductmate Industries, Inc.
 2. Lindab.
 3. Lockformer.
 4. McGill Airflow.
 5. Nexus Inc.
 6. Semco, Inc.
 7. Ward Industries.
- C. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- D. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- E. Flat-Oval, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible. Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams.
- F. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
- G. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- H. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- I. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
 - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
 - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
 - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
 4. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 5. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 6. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 7. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 8. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch

- thick with 2-piece welded construction.
9. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

2.6 DUCTWORK LINING:

- A. Ductwork liner shall be Johns Manville Linacoustic RC. Ductwork liner as manufactured by Knauf, Owens-Corning or Certain-Teed will be acceptable if equal. The product name is to be imprinted on the air stream surface.
- B. Ductwork Liner shall be installed in accordance with the Sheet Metal and Air Conditioning Contractor's National Association Duct Liner Application Standard, Second Edition, shall meet ASTM C1071 standards and liner facing must meet EPA registration requirements for antimicrobial protection.
- C. Transfer air duct shall be provided with ½" duct lining with reinforced air side coating and anti-microbial protection.
1. 1/2" thick liner to be 1-1/2 pcf density, shall have a minimum sound NRC of 0.55 based on a Type "A" mounting, and a "K" factor not exceeding 0.46 at 75° F mean temperature.
- D. Supply, return and exhaust air duct shall be provided with 1 ½" duct lining with reinforced air side coating and anti-microbial protection.
1. 1 1/2" thick liner to be 1-1/2 pcf density, shall have a minimum sound NRC of 0.85 based on a Type "A" mounting, and a "K" factor not exceeding 0.16 at 75° F mean temperature.
- E. Unless otherwise indicated, the duct dimensions given on the drawings are to be clear inside dimensions after insulation is applied.
- F. Round ductwork indicated to be lined shall be lined with 1" thick "Permacote Spiracoustic Plus" insulation manufactured by Johns Manville. Liner shall be installed per manufacturer's recommendations and requirements.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
1. Supply Ducts (upstream of VAV's): +4".
2. Supply Ducts (downstream of VAV's): +2".
3. Return Ducts (Negative Pressure): -2".
4. Exhaust Ducts (Negative Pressure): -4".
- B. Materials: Unless otherwise indicated, construct ducts according to the following:
1. Supply, return, outdoor air, and exhaust ductwork (other than noted below):
- a. Galvanized Steel
2. Exhaust ductwork connected to VAV 2-3E, 2-6E, 2-7E and 2-8E:
- a. Aluminum for all concealed ductwork and ductwork located in Mechanical/Storage 202 up to main exhaust duct.
- b. Stainless Steel for ductwork located exposed to view in occupied space.

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07.
- O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.3 SEAM AND JOINT SEALING

- A. Seal all duct seams and joints to the most severe requirement between the latest Chicago Building Code and SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

- B. Utilize sealant designed for outdoor use with ductwork exposed to the outdoors.
- C. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof- test) load.
- D. For concrete structure installations: Install concrete inserts before placing concrete.
- E. For concrete structure installations: Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCTWORK LINER:

- A. Line the first 10' of ductwork upstream and downstream of AHU-1 and downstream of AHU-2. Liner shall be applied to ductwork indicated on plans for lining application.
- B. Duct liner shall be cut to assure overlapped and compressed longitudinal corner joints. Cut edges shall be properly sealed with mastic to assure no erosion of insulation.
- C. Fasteners shall start within 3" of the upstream transverse edges of the duct liner and 3" from the longitudinal joints and shall be spaced at a maximum of 12" o.c. except that they shall be placed not more than 6" from a longitudinal joint of the liner nor 12" from a corner break.
- D. Duct liner shall be adhered to the sheet metal (with 100% coverage) and edges coated with one (1) of the adhesives conforming to the Standard for Adhesives for Duct Liner, ASC-A-7001C - 1972 of the Adhesive and Sealant Council, Inc.
- E. Duct liner shall be further secured with fasteners conforming to the Mechanical Fastener Standard, MF-1-1975 on Page 22 of the Duct Liner Application Standard, Second Edition, of the Sheet Metal and Air Conditioning Contractor's National Association.
- F. Duct liner in medium pressure ductwork shall be installed per manufacturer's recommendations for velocities above 2,000 fpm.
- G. The leading edge of duct liner joints (in direction of air flow) shall be provided with metal nosing

or a hardening mastic to prevent lining from coming loose.

3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat- oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2- inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
 - 4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

END OF SECTION 233113

**SECTION 233300
AIR DUCT ACCESSORIES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following:
1. Control dampers
 2. Volume dampers.
 3. Turning vanes.
 4. Duct-mounting access doors.
 5. Flexible connectors.
 6. Flexible ducts.
 7. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For the following:
1. Control dampers
 2. Volume dampers.
 3. Turning vanes.
 4. Duct-mounting access doors.
 5. Flexible connectors.
 6. Flexible ducts.
 7. Duct accessory hardware.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Special fittings.
 2. Backdraft dampers.
 3. Manual-volume damper installations.
 4. Motorized-control damper installations.
 5. Fire-damper and combination fire- and smoke-damper installations, including sleeves and duct- mounting access doors.
 6. Duct mounted access doors.
 7. Flexible connectors.
 8. Flexible ducts.
 9. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 DELIVERY, STORAGE AND HANDLING

- A. Materials delivered to the site must be coordinated with the site supervisor prior to delivery.
- B. All materials shall be stored in a designated area and protected from the environment.
- C. All materials shall be secured so as not to be a hazard during the construction process.
- D. All materials must be free of all dirt, debris and moisture during the installation process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Volume Dampers
 - a. Nailor.
 - b. Ruskin.
 - c. Pottorff
 - 2. Duct-Mounting Access Doors:
 - a. CESCO Products.
 - b. Ductmate Industries.
 - c. Greenheck.
 - 3. Flexible Connectors:
 - a. Ductmate Industries.
 - b. Ventfabrics, Inc.
 - c. Ward Industries.
 - 4. Flexible Ducts:
 - a. Flexmaster USA.(MCA-TLD)
 - b. Cleavaflex (DBA)
 - c. Novaflex (T/L-AM)

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M Type 304 (specify Type 314 as required by the application).
- D. Aluminum Sheets: ASTM B 209 alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 CONTROL DAMPERS

- A. General Requirements:
 - 1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
 - 2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.
- B. Performance:
 - 1. AMCA Certification: Test and rate in accordance with AMCA 511.
 - 2. Leakage:
 - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
 - 3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
 - 4. Velocity: Up to 3000 fpm.
 - 5. Temperature: Minus 25 to plus 180 deg F.
 - 6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
- C. Construction:
 - 1. Linkage out of airstream.
 - 2. Suitable for horizontal or vertical airflow applications.
 - 3. Frames:
 - a. Hat, U, or angle shaped.
 - b. 16-gauge- thick, galvanized sheet steel
 - c. Interlocking, gusseted corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Multiple blade with maximum blade width of 6 inches.
 - b. Parallel-blade design.
 - c. Galvanized steel.
 - d. 14-gauge- thick.
 - 5. Blade Edging Seals:
 - a. Replaceable silicone
 - b. Inflatable seal blade edging, or replaceable rubber seals.
 - 6. Blade Jamb Seal: Flexible stainless steel, compression type.
 - 7. Blade Axles: 1/2-inch (13-mm) diameter; galvanized steel.
 - 8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
 - 9. Bearings:
 - a. Molded synthetic
 - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.
- D. Damper Actuator - Electric:
 - 1. Electric - 24 V ac
 - 2. UL 873, plenum rated.
 - 3. Two position.

- a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Minimum 90-degree drive rotation.
 4. Clockwise or counterclockwise drive rotation as required for application.
 5. Environmental Operating Range:
 - a. Temperature: Minus 40 to plus 130 deg F ((Minus 40 to plus 55 deg C)).
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
 6. Environmental enclosure: NEMA 2.
 7. Actuator to be factory mounted and provided with a single-point wiring connection.
- E. Controllers, Electrical Devices, and Wiring:
 1. Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 2. Electrical Connection: 24 V, 60 Hz.

2.4 VOLUME DAMPERS

- A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream and suitable for horizontal or vertical applications.
 1. Steel Frames (For use in steel ductwork): Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades (For use with steel frames): 0.064-inch- thick, galvanized sheet steel.
 3. Aluminum Frames (For use in stainless steel or aluminum ductwork): Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 4. Roll-Formed Aluminum Blades (For use with aluminum frames): 0.10-inch- thick aluminum sheet.
 5. Extruded-Aluminum Blades (For use with aluminum frames): 0.050-inch- thick extruded aluminum.
 6. Blade Axles: Galvanized steel. Drive shaft will be the full length of the blade.
 7. Bearings: Stainless-steel sleeve.
 8. Tie Bars and Brackets: Aluminum (aluminum or stainless steel ductwork applications), Galvanized steel (galvanized steel ductwork applications).
- C. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 1. Steel Frames (For use in steel ductwork) : galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades (For use with steel frames): 0.064-inch- thick, galvanized sheet steel.
 3. Aluminum Frames (For use in stainless steel or aluminum ductwork) : 0.10-inch- thick,

- aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades (For use with aluminum frames): 0.10-inch- thick aluminum sheet.
 5. Extruded-Aluminum Blades (For use with aluminum frames): 0.050-inch- thick extruded aluminum.
 6. Blade Axles: Galvanized steel. Drive shaft will be the full length of the blade.
 7. Bearings: Stainless-steel sleeve thrust or ball.
 8. Blade Seals: Neoprene.
 9. Jamb Seals: Cambered stainless steel.
 10. Tie Bars and Brackets: Aluminum (aluminum or stainless steel ductwork applications), Galvanized steel (galvanized steel ductwork applications).
- D. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple- damper assembly.
- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include piano hinge and cam latches.
1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 2. Provide number of hinges and locks as follows:
 - a. Less than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Continuous hinge and two sash locks.
 - c. Larger than 18 inches square: Continuous hinge and two compression latches with outside and inside handles.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
1. Frame: Galvanized sheet steel, with spin-in notched frame.

- D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.
 - 1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- F. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.
- C. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- D. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.8 FLEXIBLE DUCTS

- A. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F
- B. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm- gear action, in sizes 3 through 18 inches to suit duct size.

2.9 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- E. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- G. Install duct silencers rigidly to ducts.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining duct accessories, control devices - sensors and terminal units as follows:
 - 1. On both sides of duct coils. On terminal units coordinate upstream coil access door with equipment supplier.
 - 2. Downstream from volume dampers, turning vanes, and duct mounted equipment.
 - 3. Adjacent to fire dampers, providing access to reset or reinstall fusible links.
 - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 - 5. On sides of ducts where adequate clearance is available.
 - 6. Where indicated on plans.
 - 7. Upstream and downstream of ducted fans.
- I. Label access doors according to Division 23 Section "Identification for HVAC."
- J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- K. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- L. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- M. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- N. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- O. Install duct test holes where indicated and required for testing and balancing purposes.
- P. Provide turning vanes in all short radius / square elbows (>45 degrees) and tees.

- Q. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
- R. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
- D. Clean louver surfaces in accordance with manufacturer's instructions.
- E. Touch-up, repair or replace damaged products before Substantial Completion.

3.3 DEMONSTRATION AND COMMISSIONING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the duct accessories.
 - 1. Train Owner's maintenance personnel on troubleshooting, servicing, and maintaining duct accessories. The training will occur after all devices are installed including all access doors. The trainer will provide two (2) Installation and Operations manuals for the use of the owners personnel during training.
 - 2. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data." All required and recommended maintenance will be reviewed as well as operational trouble shooting. If the IOM does not include a written trouble shooting guide one will be provided.
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
 - 4. Training will occur in one (1) two (2) hour session and will include the dropping and resetting of 3 fire dampers selected by the owner. This portion of the training may not take longer than 30 minutes of the training session.
- B. Demonstrate proper operation of equipment to commissioning agent or designated owners personnel. The scope of the demonstration will include functional performance requirements under both local and building automation control as well as any commissioning requirements in Division 01 or 23.
 - 1. For all fire dampers or access doors for fire dampers installed on this project the Contractor will demonstrate that any fire dampers selected by the owner can be dropped and reset using the provided access doors.

END OF SECTION 233300

**SECTION 233423
HVAC POWER VENTILATORS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Ceiling-mounted ventilators.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Provide wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.
- D. Field Quality-Control Test Reports: Submit reports documenting the activities required to be performed in PART 3. These reports are to be submitted two weeks after the startup is completed.
- E. Training Reports: Submit reports on training documenting dates and attendance.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.5 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.7 EXTRA MATERIALS

- A. Furnish one set of belts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 WARRANTY

- A. Refer to Division 01 60 00 Product Requirements specification for warranty registration requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide fans by one of the following:
 - 1. Loren Cook Company.
 - 2. Greenheck.
 - 3. Penn Ventilation.
 - 4. Twin City

2.2 CEILING CABINET FANS

- A. Housing: Steel.
- B. Fan Wheel: Centrifugal wheels directly mounted on motor shaft.
- C. Back-draft damper: Integral.
- D. Electrical Requirements: Junction box for electrical connection on housing.
- E. Accessories:
 - 1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2. Include grille and disconnect switch.

2.3 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support units using spring isolators having a static deflection of 1 inch.
 1. Secure vibration to concrete bases using anchor bolts cast in concrete base.
- C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware
- D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch.
- F. Install units with clearances for service and maintenance.
- G. Label units according to requirements specified in Division 23 Section "Identification for HVAC."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Conductors and Cables for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Division 01 Section "Contract Closeout."
- C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.
- D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

3.6 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.7 CONTRACTOR STARTUP AND REPORTING

- A. Final Checks before Startup: Perform the following operations and checks before startup. Startup service includes the testing, inspections and startup test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
 - 7. Disable automatic temperature-control operators.
- B. Starting procedures for fans are as follows:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor voltage and amperage.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.
- E. Replace fan and motor pulleys as required to achieve design conditions.

3.8 DEMONSTRATION AND COMMISSIONING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fans.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining chillers. The training will occur after the startup report has been provided to the owner and the trainer will provide two (2) Installation and Operations manuals for the use of the owner's personnel during training.
 - 2. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data." All required and recommended maintenance will be reviewed as well as operational troubleshooting. If the IOM does not include a written troubleshooting guide one will be provided.
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

- B. Demonstrate proper operation of equipment to commissioning agent or designated owners personnel. The scope of the demonstration will include functional performance requirements under both local and building automation control as well as any commissioning requirements in Division 01 and 23.

END OF SECTION 233423

**SECTION 233713
DIFFUSERS, REGISTERS, AND GRILLES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Louver face diffusers.
 - 2. Slot diffusers
 - 3. Adjustable bar registers and grilles.
 - 4. Fixed face grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Louver Face Diffuser:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Tuttle & Bailey.
 - d. Krueger.
 - 2. Material: Aluminum
 - 3. Finish: Baked enamel, white.
 - 4. Neck Size: As scheduled.
 - 5. Mounting: T-bar in 24 x 24 mounting panel or plaster frame

6. Pattern: As indicated on Drawing Schedule.
7. Accessories:
 - a. Square to round neck adaptor.

B. Slot Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Tuttle & Bailey.
 - d. Krueger.
2. Material: Aluminum
3. Finish: Baked enamel, white.
4. Neck Size: As scheduled.
5. Mounting: Surface mount
6. Pattern: As indicated on Drawing Schedule.
7. Accessories:
 - a. Insulated plenum and end caps.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Tuttle & Bailey.
 - d. Krueger.
2. Material: Aluminum
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Spaced 3/4 inch apart.
5. Rear-Blade Arrangement: Spaced 3/4 inch apart.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade.

B. Adjustable Bar Grille:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Tuttle & Bailey.
 - d. Krueger.

1. Material: Aluminum
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Spaced 3/4 inch apart.
4. Frame: 1-1/4 inches wide.
5. Mounting: Countersunk screw.

B. Fixed Face Grille:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Tuttle & Bailey.
 - d. Krueger.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Arrangement: Spaced 3/4 inch apart.
5. Frame: 1-1/4 inches wide.
6. Mounting: Lay in.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 235533.16
GAS-FIRED UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gas-fired unit heaters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of gas-fired unit heater.
 - 1. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: For gas-fired unit heaters. Include plans, elevations, sections, and attachment details.
 - 1. Prepare by or under the supervision of a qualified professional engineer detailing fabrication and assembly of gas-fired unit heaters, as well as procedures and diagrams.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, 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. Structural members to which equipment will be attached.
 - 2. Items penetrating roof and the following:
 - a. Vent and gas piping rough-ins and connections.
- B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit heater that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Reznor
- B. Modine
- C. Trane

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Capacities and Characteristics:
 - 1. See schedules on plan.
- C. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- D. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- E. Type of Venting: Indoor, separated combustion, power vented.
- F. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
 - 1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
- G. Accessories:
 - 1. Four-point suspension kit.
 - 2. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.

- H. Heat Exchanger: Stainless steel.
- I. Burner Material: Stainless steel.
- J. Centrifugal Unit Fan:
 - 1. Steel, centrifugal fan dynamically balanced and resiliently mounted.
 - 2. Belt-Driven Drive Assembly:
 - a. Resiliently mounted to housing, with the following features:
 - 1) Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2) Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3) Pulleys: Cast-iron, adjustable-pitch motor pulley.
- K. Motors:
 - 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 2. Enclosure Materials: Rolled steel.
- L. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
 - 1. Wall-Mounted Thermostat:
- M. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written instructions.

3.2 EQUIPMENT MOUNTING

- A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
- B. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.
 - 1. Spring hangers are specified in Section 230548 "Vibration Controls for HVAC."
 - 2. Threaded Rods, Spring Hangers, Building Attachments, and Seismic Restraints: Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." and Section 230548 "Vibration and Seismic Controls for HVAC."
 - 3. Anchor the unit to resist code-required horizontal acceleration.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.
- C. Vent Connections: Comply with Section 235123 "Gas Vents."
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 2. Verify bearing lubrication.
 - 3. Verify proper motor rotation.
 - 4. Test Reports: Prepare a written report to record the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- B. Gas-fired unit heater will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain gas-fired unit heaters.

END OF SECTION 235533.16

SECTION 237433
DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 DEFINITIONS:

- A. ECM: Electronically commutated motor.
- B. IS COP: Integrated Seasonal Coefficient of Performance.
- C. ISMRE: Integrated Seasonal Moisture Removal Efficiency.
- D. MRC: Moisture Removal Capacity.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Delegated Design Submittal: For design of vibration isolation, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting details, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Seismic Qualification Certificates: For dedicated outdoor-air units, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 4. Restraint of internal components.
 - C. Startup service reports.
 - D. Sample warranty.
- 1.6 CLOSEOUT SUBMITTALS
 - A. Operation and Maintenance Data.
- 1.7 WARRANTY
 - A. Warranty: Manufacturer agrees to replace components of dedicated outdoor-air units that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Compressors: Five years from date of Substantial Completion.
 2. Warranty Period for Rotary Heat Exchangers: Five 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 on Drawings or comparable product by one of the following:
 1. Trane.
 2. Aeon.
 3. CaptiveAire.
 4. Valent.
- 2.2 PERFORMANCE REQUIREMENTS
 - A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 "Construction and System Start-up".
 - B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation.
 - C. Cabinet Thermal Performance:
 1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
 2. Maximum Overall U-Value: 0.14 Btu/h x sq. ft. x deg F.
 3. Include effects of metal-to-metal contact and thermal bridges in the calculations.
 - D. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
 2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.
- E. Maximum Cabinet Leakage: 1 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.
- F. Cabinet Deflection Performance:
1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
 2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:
 - a. Service personnel.
 - b. Internal components.
 - c. Design working pressure defined for the walls and roof.
- G. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

- A. Size 1 unit(s) cabinets shall be constructed of minimum 24-gauge. Sizes 2, 3, or 4 cabinets shall be 20-gauge G-90 galvanized steel riveted together via structural pop-rivets. All metal shall be CNC bent for precise assembly.
1. Rigging Provisions: The unit shall have a structural base constructed of minimum 18-gauge in cabinet size 1 and 14-gauge in cabinet sizes 2, 3 & 4 G-90 galvanized steel, and include full sized fork pockets and lifting points on all four sides.
 2. Roof Construction: The lids shall be fabricated by forming a double-standing, self-locking seam that requires no additional support. Roof shall be pitched to allow for proper drainage.
 3. Exterior Wall Construction: All exterior walls shall consist of a double wall, G-90 galvanized steel construction. Cabinet size 1 shall be insulated with 1-inch thick, R4.3 fiber glass duct board insulation. Cabinet sizes 2, 3 & 4 shall be insulated with 2-inch thick, R13 closed cell foam.
 4. Service Access Doors: All door jambs shall be gasketed around their perimeter, and allow for doors to be mounted via removable, spring actuated, stainless steel hinges with stainless steel rivets, and self-compressing latches. Each compartment shall have removable access panels to allow for ease of service and maintainability. Electrical cabinet access doors shall have a door hold installed to prop doors open. All doors shall have stainless steel latches which are pad lockable. Electrical cabinet doors shall be outfitted with schematic/manual pouches formed into the door, along with wiring diagram attached to the indoor of the door from the factory.
- B. Entire interior and exterior casing shall be constructed of minimum G90 galvanized steel. Unit shall have undergone a salt spray corrosion test as per ASTM B 117.

- ~~C. Entire unit shall be Miami-Dade wind rated up to ± 150 psf per TAS 201, 202 & 203 on any units utilizing a 20" or shorter factory provided roof curb.~~

D. ERV Section

1. Unit(s) shall be constructed of minimum 24ga. in cabinet size 1 or 20ga. in cabinet sizes 2, 3 or 4 G-90 galvanized steel riveted together via structural pop-rivets. All metal shall be CNC bent for precise assembly.
2. Rigging Provisions: The unit shall have a structural base constructed of minimum 18 ga. in cabinet size 1 and 14ga. in cabinet sizes 2, 3 & 4 G-90 galvanized steel, and include full sized fork pockets on two sides and lifting points on all four sides.
3. Mating Procedure: The module shall be mated to the host DOAS from the factory using brackets constructed of minimum 14 ga. in cabinet size 1 and 12 ga. 2, 3 & 4 G-90 galvanized steel.
4. Roof Construction: The lids shall be fabricated by forming a double-standing, self locking seam that requires no additional support. Roof shall be pitched to allow for proper drainage. An additional bracket shall be installed that interlocks the roof of the ERV module with the host DOAS.
5. Exterior Wall Construction: All exterior walls shall consist of a double wall, G-90 galvanized steel construction. Size 1 cabinets shall be insulated with 1in. thick, R4.3 fiber glass duct board insulation. Cabinet sizes 2, 3 & 4 shall be insulated with 2in. thick, R13 closed cell foam.
6. Service Access Doors: All door jambs shall be gasketed around their perimeter, and allow for doors to be mounted via removable, spring actuated, stainless steel hinges with stainless steel rivets, and self-compressing latches. Each compartment shall have removable access panels to allow for ease of service and maintainability. Electrical cabinet access doors shall have a door hold installed to prop doors open. All doors shall have stainless steel latches which are pad lockable. Electrical cabinet doors shall be outfitted with schematic/manual pouches formed into the door, along with wiring diagram attached to the interior of the door from the factory.

2.4 AIRFLOW CONFIGURATIONS

- A. Discharge: Unit shall be side (horizontal) discharge through the unit's base.
- B. Return: Unit shall also side (horizontal) Return through the unit's base
- C. Intake Airflow: Unit configuration shall be through use of a fresh/outdoor and return air damper.
 1. Damper: Shall exceed AMCA Class 1A standard for low leakage. Damper assembly shall be a single assembly, and outfitted with an integral bird screen and louver/gutter system to divert any drainage through the base of the unit – intake air hood not required.
 2. Actuator: A single direct drive damper actuator shall be used with spring return to ensure that the outdoor air section closes when not powered.

2.5 SUPPLY AIR BLOWER AND MOTOR

- A. All supply fans shall be direct drive (belt-drive not acceptable) variable speed plenum fans.
- B. Blower Motor: Motor shall be a premium efficiency motor available as:
 1. Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) motor driven by a Variable Frequency Drive.
- C. Fans to be selected at or near efficiency peak. (Submit fan curves).

- D. Blower and motor assembly shall be dynamically balanced. The entire blower and motor assembly shall be mounted on rubber vibration isolators. Wheels balanced as per AMCA 204-96, Balance Quality and Vibration Levels for fans.
- E. Unit equipped with total CFM monitoring to measure airflow across supply discharge.

2.6 EXHAUST AIR BLOWER AND MOTOR

- A. All exhaust fans shall be direct drive (belt-driven not acceptable) variable speed plenum fans.
- B. Blower Motor: Motor shall be a premium efficiency motor available as:
 - 1. Electronically Commutated Motor (ECM).
 - 2. Vibration Isolation: Blower assembly shall be mounted on rubber vibration isolators to reduce transmission of vibration to the building structure.
- C. Fans to be selected at or near efficiency peak. (Submit fan curves.)
- D. Blower and motor assembly shall be dynamically balanced. The entire blower and motor assembly shall be mounted on rubber vibration isolators. Wheels balanced as per AMCA 204-96, Balance Quality and Vibration Levels for fans.

2.7 ENERGY RECOVERY WHEEL

- A. Unit shall utilize a variable speed polymer energy recovery wheel with the following features:
 - 1. Modulation: ERV wheel motor shall be capable of speed modulation that correlates to 16-60 rpm on all size ERV wheels.
 - 2. Self Cleaning: Opposing airflows draw debris off of both sides of the wheel. Time or manually activated cleaning cycles are available for times the ERV sits idle.
 - 3. Defrost Cycles: If outdoor and return conditions present a risk of freezing, the energy wheel shall slow down to decrease energy transfer and defrost the wheel.
 - 4. Internal Overload Protection: Energy recovery wheel drive motor shall include internal thermal overload protection to protect against excessive motor temperatures.
 - 5. Initial Stage: Energy recovery wheel shall start as the first stage of heating or cooling prior to the DOAS starting to minimize energy consumption.
 - 6. Segmented Media: Energy wheel is constructed of individual segmented media sections, allowing for replacement of single individual sections rather than the entire wheel in the event of maintenance or repair needs.
 - 7. Media Construction: Media is constructed of a durable lightweight polymer, which is permanently bonded by a silica gel dessicant for both sensible and latent heat recovery.
 - 8. Purge Segment: Wheel is outfitted with an adjustable purge segment to minimize EATR.
 - 9. Motor: Wheel driven by a belt drive motor with motor speed controls to allow for wheel speed modulation.
- B. To help mitigate any long-term potential for hardware failures, the unit shall be outfitted with the following protection measures:
 - 1. Energy Wheel Malfunction Detection, if the ERV detects lack of energy transfer in the presence of a scenario with a large transfer potential the unit will report an error over CASLink and trigger DOAS activation.
 - 2. Clogged Filter and Energy Wheel monitoring, ERV will report high static pressures if present on the energy wheel or filter to indicate the need for servicing.
 - 3. Missing Filter monitoring, ERV will report low static pressures if present in the filter banks to indicate the need for servicing.

2.8 REFRIGERATION SYSTEM

- A. Unit shall utilize a variable speed inverter duty scroll compressor with the following features:
1. Modulation: Compressor shall be capable of compressor speed modulation from 15%-100% on 5, 6, 7.5, 8, 10, & 12.5 Ton units. Compressor shall be capable of compressor speed modulation from 25%-100% on 15, 20, 22, 25, 30, 40, and 50 Ton units.
 2. Refrigerant: Unit shall be factory charged with R410A refrigerant.
 3. Vibration Isolation: Compressor as well as blower assembly shall each be mounted on rubber vibration isolators to reduce transmission of vibration to the building structure.
 4. Internal Overload Protection: Compressor shall include internal thermal overload protection to protect against excessive motor temperatures.
 5. Crankcase Heater: Compressor shall include a crankcase heater to protect against liquid flood-back and elimination of oil foaming on startup. The crankcase heater must remain powered when the compressor is not in operation.
 6. Oil Management: Unit shall utilize both passive and active oil return management using Oil Level Sensor and scheduled oil boosts.
 7. Monitored Envelope: Unit shall monitor all critical refrigeration points to ensure compressor does not operate outside of safe operating envelope.
 8. Throttling Logic: Unit shall allow for high head pressure monitoring throttle mode for high ambient operation, and low suction pressure throttle mode for low capacity operation or any conditions resulting in low suction pressure.
 9. Pump-Down: Active pump-down mode with discharge line check valve to protect against liquid migration into compressor during idle times.
 - ~~10. Defrost mode in optional Heat Pump: When outdoor coils are deemed at risk of freezing, the unit shall simultaneously turn on auxiliary heat while running the heat pump in "cooling" mode to help defrost outdoor coils as needed while still maintaining desired leaving air temperatures.~~
- B. The unit shall be outfitted with the following:
1. Indoor Coil: Indoor coil shall be a high efficiency 4-10 row coil design with aluminum fins mechanically bonded to copper tubes. Coil is staggered to increase turbulence, reduce the coil bypass factor, and ultimately increase the time the air stays within the coil. Includes two probe sensors to read average coil face temperature.
 2. Electronic Expansion Valve: Each refrigeration circuit will be outfitted with an electronic expansion valve metering device which can be throttled from 0-100% open to allow for precise superheat control.
 3. Indoor Coil Drain Pan: The indoor coil shall be outfitted with a sloped stainless steel drain pan. This pan shall be insulated along the entire base to prevent condensation, and outfitted with a safety overflow switch which will automatically shut down cooling operation prior to water overflowing the drain pan in the event of a drain clog. The entire drain pan shall be 20 GA Stainless Steel construction and wrap beneath the entire coil with flashing on entering side of coil to ensure capture of all condensate. Drain pan discharge pipe shall also be stainless steel construction. Drain pan shall be pitched to exceed ASHRAE 62.1 standard.
 4. Base of the condensing coil cabinet shall be pitched away from the unit as a safety to ensure all draining exits away from the curb.
 5. Hot Gas Reheat Coil: The unit shall include an optional copper tube and aluminum fin hot gas reheat coil mounted downstream of the indoor coil. This coil shall be controlled via fully modulating hot gas reheat valve to provide precise reheat temperature control. This coil shall include the addition of an evaporative coil leaving condition sensor to maintain a coil dew point. This also prevents operation of a dehumidification call when intake dew point conditions are found to be below space dew point conditions, preventing wasted energy.
 6. Outdoor (Condenser) Coil: Outdoor coil shall be a high efficiency coil design with aluminum fins mechanically bonded to copper tubes. The coil shall be downward sloped to protect coil from hail damage. Optional hail guards may also be outfitted to the outdoor coil for added protection from hail bouncing off the unit's roof up the coil.

7. Outdoor Fans: The outdoor coil shall have a vertical discharge outfitted with quiet, efficient, fully modulating Electronically Commutated Motor (ECM) condensing fans. These fans shall modulate to maintain a temperature differential between outside air and the outdoor coil.
- C. To help mitigate any long-term potential for leaks or hardware failures, the unit shall be outfitted with the following protection measures:
 1. Suction line accumulator for added protection against liquid entering suction line of compressor.
 2. Bi-flow, low pressure drop, filter drier.
 3. Electronic Expansion Valve (EEV) for precise superheat control. EEV shall open partially allowing system pressure equalization prior to activation of the compressor.
 - ~~4. On optional heat pump units, use of a single 3-way reheat valve to prevent obstructions due to valve failure.~~
 5. Protective rubber sleeves installed on all distribution lines of indoor coil to prevent wear from rubbing.
 6. All refrigeration ports shall be short-stub assembly and any access port with a transducer or switch is mounted vertically to mitigate risk of bent/cracked stub joints.
 7. Refrigeration circuit shall be mechanically CNC pre-bent tubing wherever possible with minimal brazed joints to minimize points for potential refrigeration leaks.
 8. Factory tested for leaks via high pressure nitrogen decay and helium tracer gas testing.
 9. Suction line temperature sensor failure detection.
 10. Preventative failure alerts through a manufacturer provided, cloud based, cellular remote monitoring system.

2.9 HEATING SYSTEM

- A. The gas burner shall be an indirect-fired, push-through type, using natural gas or liquid propane gas. The inlet-supply pressure to the unit for natural gas must be 7" w.c. minimum. For liquid propane gas, the minimum must be 11" w.c.
- B. Burner shall be a tubular in-shot fired design capable of using natural or LP type gas. Each burner ignition shall be of the direct-spark design with remote flame sensing at inlet of the last firing tube of the gas manifold.
- C. Direct-sparking sequence shall last through the complete duration of the trial for ignition period for guaranteed light-off. Burner shall always be lit at maximum gas flow and combustion airflow for guaranteed light-off. Each burner ignition module shall have LED indicators for troubleshooting and a set of exposed prongs for testing flame indication signal.
- D. All furnaces shall be controlled by an electronic Vernier-type fully modulating control system capable of achieving 81% combustion efficiency over the entire gas firing range of the unit.
- E. Each furnace shall have:
 1. A minimum turndown ratio of 6:1 for natural gas and 5:1 for LP gas while maintaining a constant 81% efficiency (90% for high efficiency furnace option). No cold air bypass of the heat exchanger.
 2. Each furnace heat exchanger shall be a bent-tube style design made entirely of stainless steel.
 3. Stainless steel Quick Seal Connection for gas connection.
 4. Manifold and Input gas pressure gauges.
 5. Factory piped condensate drain to exterior of cabinet.
 6. A combustion flue to be installed on adjacent side as combustion intake with integrated high velocity wind cap.

7. A blocked vent safety airflow switch with high temperature silicone tubing operating off of absolute pressure measured inside of the power-vent blower housing.
8. A high temperature auto-recycling limit with a maximum non-adjustable set point.
9. A manual reset high temperature flame roll out switch with a non-adjustable set point.
10. Each furnace compartment shall have a removable post and panel that allows the furnace to be easily removed for service and maintainability.
11. A power-vent assembly for exhausting flue gases with a PSC or ECM type motor that is securely mounted and easily accessible/removable for service.
12. A 0-10" w.c. gas pressure gauge installed on the gas manifold.

2.10 FILTERS

- A. Provide filters as part of unit. All filters shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified under another section of this work.
- B. All filters shall be installed on tracks for easy removal from the unit.
- C. Up to 3 layers of outdoor air filtration installed. Unit shall ship with a 2" washable metal mesh outdoor air filter. Mixed air shall have optional 2" MERV-8. Mixed air shall have optional MERV-13 filters. Mixed air shall have optional 4" MERV-15. Mixed air shall have optional 4" HEPA filter banks factory installed.
- D. Unit shall have an optional adjustable pressure differential sensor for the filter bank to alert in the event of a clogged filter.

2.11 ELECTRICAL

- A. All controls shall be pre-wired and housed in an insulated electrical cabinet within the unit to protect against risk of condensation.
- B. Units shall be provided with single point electrical connection or separate electrical heat connection.
- C. Unit shall be provided with a door safety switch that de-energizes the supply fan when the door is opened.
- D. Unit shall be provided with a factory mounted averaging supply air temperature sensor to allow for accurate discharge temperature readings within unit when a downstream sensor is not installed. Field mounted and wired discharge air sensors will not be accepted.
- E. Unit shall be provided with a factory mounted averaging intake air temperature sensor to allow for accurate intake temperature reading regardless of how the OA/RA dampers are positioned.
- F. The electrical cabinet shall be outfitted with the following:
 1. LED electrical cabinet service light with automatic activation upon door switch.
 2. Color wiring schematics, laminated to the interior wall of the cabinet doors.
 3. Factory mounted disconnect with unit bottom knockouts.
 4. A LED backlit, LCD Human-Machine Interface (HMI) shall be mounted within the unit's control cabinet to allow for all set points configuration and refrigeration system monitoring at the unit.
 5. Up to 4 additional space mounted HMIs available. Additional HMIs shall allow for full programming capabilities and are outfitted with integral temperature and humidity sensors.

Additional HMIs shall be capable of being individually averaged for space temperature/humidity readings. All HMIs shall be wired using standard CAT5/6 cables.

6. Optional 120V, 15A unit powered or unpowered convenience outlet.

- G. All sensors shall be wired back to the main control board that continuously monitors all critical components and makes decisions based on pre-determined logic to accurately control the following:

1. PID logic to control heater modulation ensuring precise discharge/space temperature control.
2. PID logic to control compressor speed to provide precise control over evaporative coil temperatures, leaving dew point, and discharge/space temperatures.
3. PID logic for Outdoor fan modulation to maintain an optimal outdoor coil temperature.
4. PID logic for Electronic Expansion Valve (EEV) position to maintain a precise superheat temperature
5. PID logic for Modulating Reheat valve to limit supply air temperature and relative humidity based off of space or discharge conditions.

2.12 CONTROLS

- A. Unit shall be outfitted with a control board to allow for full control of the entire unit.
- B. Provide air flow switch on the supply fan system to sense air flow with available set of contacts for connection to BMS for airflow alerts.
- C. All unit controls shall be compatible with BACnet and LonWorks based building management systems.
- D. All units shall be outfitted with CASLink cloud based monitoring, which monitors every point of operation. Provides configurable automated fault alert e-mails, and remote control capabilities.
- E. Integrated cellular module to provide remote connection to monitoring services to view both real time and historical unit operation. Data shall be stored a minimum of 3 years on the cloud. Data sample rate shall be a maximum of 60 seconds.

~~F. Temperature Control System~~

- ~~1. Low Ambient Cooling: Unit is factory outfitted with logic allowing for low ambient operation of the DX system~~
 - ~~a. Standard low-ambient operation: Unit(s) with a DX system may operate down to 0°F outdoor temperatures purely through software utilizing the standard factory modulating components.~~
 - ~~b. Extreme low-ambient operation: Unit(s) with a DX system may operate to extreme low ambient conditions, down to -25°F outdoor temperatures, are factory fitted with a bypass solenoid.~~

2.13 ROOF CURB

- A. Unit shall be factory assembled, and constructed of 18GA galvanized steel, with optional 16GA available.
- B. Curb shall be fully insulated with 1" acoustical and thermal insulation.
- C. Curb shall be factory outfitted with duct support hangers.

2.14 VARIABLE FREQUENCY DRIVES

- A. Provide Variable Frequency Drive for the compressor as part of the AC unit. VFD shall be furnished and installed to meet the performance set forth in the schedule and as specified under another section of this work.
 - 1. Accessories to be furnished and mounted by the drive manufacturer and contained in a single enclosure. (The use of more than one enclosure is not acceptable).
- B. Provide Variable Frequency Drive for speed control on all non-ECM direct drive supply fans.
- C. All VFDs shall provide the following inherent protections:
 - 1. Phase protection.
 - 2. Brownout protection.
 - 3. Overload/Overheat protection.
 - 4. Soft starts to protect bearings/hardware.
 - 5. Low & High voltage & over-torque protections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual".
 - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
 - 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
 - 3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Install duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- D. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel -Gas Code".
- E. Install separate devices furnished by manufacturer and not factory installed.
- F. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- G. Install drain pipes from unit drain pans to roof drain.
 - 1. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent- welded fittings.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers".
2. Pipe Size: Same size as condensate drain pan connection.

3.2 CONNECTIONS

- A. Where installing piping adjacent to units, allow space for service and maintenance.
- B. Gas Piping Connection:
 1. Comply with requirements in Section 231123 "Facility Natural-Gas Piping."
 2. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
 3. Install AGA-approved flexible connectors.
- C. Duct Connections:
 1. Comply with requirements in Section 233113 "Metal Ducts."
 2. Drawings indicate the general arrangement of ducts.
 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."
- D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 2. Inspect units for visible damage to furnace combustion chamber.
 3. Perform the following operations for both minimum and maximum firing, and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 4. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
 5. Start refrigeration system when outdoor-air temperature is within normal operating limits. and measure and record the following:

- a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
 6. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 7. Inspect casing insulation for integrity, moisture content, and adhesion.
 8. Verify that clearances have been provided for servicing.
 9. Verify that controls are connected and operable.
 10. Verify that filters are installed.
 11. Clean coils and inspect for construction debris.
 12. Clean furnace flue and inspect for construction debris.
 13. Inspect operation of power vents.
 14. Purge gas line.
 15. Inspect and adjust vibration isolators and seismic restraints.
 16. Verify bearing lubrication.
 17. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 18. Adjust fan belts to proper alignment and tension.
 19. Start unit.
 20. Inspect and record performance of interlocks and protective devices, including response to smoke detectors by fan controls and fire alarm.
 21. Operate unit for run-in period.
 22. Calibrate controls.
 23. Adjust and inspect high-temperature limits.
 24. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 25. Verify operational sequence of controls.
 26. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air flow.
 - c. Outdoor-air flow.
 - d. Exhaust air flow.
 - B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
 - C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.
 - D. Prepare written report of the results of startup services.
- 3.4 ADJUSTING
- A. Adjust initial temperature and humidity set points.
 - B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
 - C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 237433

SECTION 238126
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) for each air-handling unit.
 - 2. Gaskets: One set(s) for each access door.
 - 3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: One year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation.
 2. Daikin.
 3. Mitsubishi Electric & Electronics USA, Inc.
 4. Trane.
 5. YORK; a Johnson Controls company.

2.2 CAPACITIES AND CHARACTERISTICS

- A. See Drawing Schedules

2.3 DUCTLESS STYLE WALL MOUNTED INDOOR UNITS

- A. General:
1. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- B. Cabinet:
1. All casings, regardless of model size, shall have the same white finish.
 2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.
 3. There shall be a separate back plate which secures the unit firmly to the wall.
- C. Fan:
1. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.
 2. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 3. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- D. Filter:
1. Return air shall be filtered by means of an easily removable, washable filter.
- E. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
 2. The coils shall be pressure tested at the factory.
- F. Electrical:
1. The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The power to the indoor unit shall be supplied from the outdoor unit, using the Mitsubishi Electric A-Control system. For A-Control, a three (3) conductor AWG-14/16

wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units.

2.4 DUCTLESS STYLE OUTDOOR UNITS

A. General:

1. The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions.
2. The outdoor unit shall be capable of cooling operation down to ambient temperature of 0°F for heat pump systems and -20°F (-29°C) for cooling only systems without additional low ambient controls (optional wind baffle shall be required).
3. The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.

B. Cabinet

1. The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a Munsell 3Y 7.8/1.1 finish.
2. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability.
3. Easy access shall be afforded to all serviceable parts by means of removable panel sections.
4. The fan grill shall be of ABS plastic.
5. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

C. Fan

1. Unit shall be furnished with a single DC fan motor.
2. The fan blade(s) shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated.
3. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

D. Coil

1. The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard.
2. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor controlled step motor.
3. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ACR Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a - Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

E. Compressor

1. The compressor shall be a DC twin-rotor rotary compressor with Variable Speed Inverter Drive Technology.

2. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings.
 3. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.
 4. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.
- F. Electrical
1. The electrical power of the unit shall be 208 volts or 230 volts, single phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
 2. Power for the indoor unit shall be supplied from the outdoor unit via Mitsubishi Electric A-Control using three (3) fourteen (14/16) gauge AWG conductors plus ground wire connecting the units.
 3. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
 4. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.
 5. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238129

VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes complete VRF HVAC system(s) including, but not limited to, delegated design and the following components to make a complete operating system(s) according to requirements indicated:
 - 1. Indoor, concealed, ceiling-mounted units for ducting.
 - 2. Indoor, concealed, floor-mounted units for ducting.
 - 3. Indoor, exposed, wall-mounted units.
 - 4. Indoor, recessed, ceiling-mounted units.
 - 5. Outdoor, air-source heat recovery units.
 - 6. Heat recovery control units.
 - 7. System controls.
 - 8. System refrigerant and oil.
 - 9. System condensate drain piping.
 - 10. System refrigerant piping.
 - 11. Metal hangers and supports.
 - 12. Metal framing systems.
 - 13. Fastener systems.
 - 14. Pipe stands.
 - 15. Equipment stands.
 - 16. Miscellaneous support materials.
 - 17. Piping and tubing insulation.
 - 18. System control cable and raceways.

1.2 DEFINITIONS

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.
- C. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- E. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

- F. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.
- G. VRF: Variable refrigerant flow.

1.3 ACTION SUBMITTALS

- A. Product data.
- B. Shop Drawings: For VRF HVAC systems.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 4. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For fully and partially exposed indoor units with factory finishes viewable by occupants.
- D. Delegated-Design Submittals:
 - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
 - 2. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing for each system installed.
 - 3. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
 - 4. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, sections, and details, drawn to scale, using input from installers of the items involved.
- B. Qualification Data:
 - 1. For Installer.
 - 2. For VRF HVAC system manufacturer.
 - 3. For VRF HVAC system provider.
- C. Product Certificates: For each type of product.

- D. Product test reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

- A. Factory-Authorized Service Representative Qualifications:
 - 1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
 - 2. Demonstrated past experience with products being installed for a period within three consecutive years before time of bid.
 - 3. Demonstrated past experience on five projects of similar complexity, scope, and value.
 - a. Each person assigned to Project shall have demonstrated past experience.
 - 4. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
 - 5. Service and maintenance staff assigned to support Project during warranty period.
 - 6. Product parts inventory to support ongoing system operation for a period of not less than five years after Substantial Completion.
 - 7. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.
 - 1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
 - 2. Installer certification shall be valid and current for duration of Project.
 - 3. Retain copies of Installer certificates on-site and make available on request.
 - 4. Each person assigned to Project shall have demonstrated past experience.
 - a. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.

- b. Demonstrated past experience on five projects of similar complexity, scope, and value.
- C. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts, Including Controls: Five year(s) from date of Substantial Completion.
 - c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Mitsubishi, Daikin, Samsung, York (Johnson Controls)

2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
 - 1. Two-pipe system design.
 - 2. System(s) operation, heat recovery as indicated on Drawings.
 - 3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. AHRI Compliance: System and equipment performance certified according to AHRI 1230.
- D. ASHRAE Compliance:
 - 1. ASHRAE 15: For safety code for mechanical refrigeration.
- E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional specialist, as defined in Section 014000 "Quality Requirements," to design complete and operational VRF HVAC system(s) complying with requirements indicated.
1. Provide system refrigerant calculations.
 - a. Refrigerant concentration limits shall be within allowable limits of ASHRAE 15 and governing codes.
 - b. Indicate compliance with manufacturer's maximum vertical and horizontal travel distances. Prepare a comparison table for each system showing calculated distances compared to manufacturer's maximum allowed distances.
 2. Include a mechanical ventilation system and gas detection system as required to comply with ASHRAE 15 and governing codes.
 3. System Refrigerant Piping and Tubing:
 - a. Arrangement: Arrange piping to interconnect indoor units, HRCUs, and outdoor unit(s) in compliance with manufacturer requirements and requirements indicated.
 - b. Routing: Conceal piping above ceilings and behind walls to maximum extent possible.
 - c. Sizing: Size piping system, using a software program acceptable to manufacturer, to provide performance requirements indicated. Consider requirements to accommodate future change requirements.
 4. System Controls:
 - a. Network arrangement.
 - b. Network interface with other building systems.
 - c. Product selection.
 - d. Sizing.
- B. Service Access:
1. Provide and document service access requirements.
 2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
 3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
 4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
 5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
 6. Comply with OSHA regulations.
- C. System Design and Installation Requirements:
1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
 2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.

- D. System Adaptability to Future Changes: Arrange and size system refrigerant piping to accommodate future changes to system without having to resize and replace existing refrigerant piping.
 - 1. Each branch circuit shall accommodate addition of one indoor unit(s) with unit capacity equal to largest indoor unit connected to the branch circuit.
 - E. Isolation of Equipment: Provide isolation valves to isolate each HRCU, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
 - F. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
 - 1. Not less than 60 percent.
 - 2. Not more than 130 percent.
 - 3. Range acceptable to manufacturer.
 - G. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.
 - H. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.
 - I. Outdoor Conditions:
 - 1. Suitable for outdoor ambient conditions encountered.
 - a. Design equipment and supports to withstand wind loads of governing code.
 - b. Design equipment and supports to withstand snow and ice loads of governing code.
 - 2. Maximum System Operating Outdoor Temperature: See Drawings.
 - 3. Minimum System Operating Outdoor Temperature: See Drawings.
 - J. Sound Performance: Sound levels generated by operating HVAC equipment shall be within requirements indicated.
 - 1. Indoor: Within design guidelines of "2015 ASHRAE HANDBOOK- HVAC Applications."
 - 2. Outdoor: Within ordinance of governing authorities.
 - K. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.
 - L. Capacities and Characteristics: As indicated on Drawings.
- 2.4 INDOOR, CONCEALED, CEILING-MOUNTED UNITS FOR DUCTING
- A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
 - B. Cabinet:
 - 1. Material: Galvanized steel.
 - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.

3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
 4. Mounting: Manufacturer-designed provisions for field installation.
 5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
 3. Coil Tubes: Copper, of diameter and thickness required by performance.
 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
 5. Unit Internal Tubing: Copper tubing with brazed joints.
 6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 7. Field Piping Connections: Manufacturer's standard.
 8. Factory Charge: Dehydrated air or nitrogen.
 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
 2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
 3. Field Piping Connection: Non-ferrous material.
- E. Fan and Motor Assembly:
1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
 - d. Wheels statically and dynamically balanced.
 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
 5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
 2. Efficiency: ASHRAE 52.2, MERV 8.
 3. Media:
 - a. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Unit Accessories:
1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

H. Unit Controls:

1. Enclosure: Metal, suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:
 - a. Unit inlet air temperature.
 - b. Coil entering refrigerant temperature.
 - c. Coil leaving refrigerant temperature.
4. Features and Functions:
 - a. Self-diagnostics.
 - b. Time delay.
 - c. Auto-restart.
 - d. External static pressure control.
 - e. Auto operation mode.
 - f. Manual operation mode.
 - g. Filter service notification.
 - h. Power consumption display.
 - i. Drain assembly high water level safety shutdown and notification.
 - j. Run test switch.
5. Communication: Network communication with other indoor and outdoor units.
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

I. Unit Electrical:

1. Enclosure: Metal, suitable for indoor locations.
2. Field Connection: Single point connection to power unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways.

2.5 INDOOR, CONCEALED, FLOOR-MOUNTED UNITS FOR DUCTING

- A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
- B. Cabinet:
1. Material: Galvanized steel.
 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
 3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
 4. Mounting: Manufacturer-designed provisions for field installation.

5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
 3. Coil Tubes: Copper, of diameter and thickness required by performance.
 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
 5. Unit Internal Tubing: Copper tubing with brazed joints.
 6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 7. Field Piping Connections: Manufacturer's standard.
 8. Factory Charge: Dehydrated air or nitrogen.
 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
 2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
 3. Field Piping Connection: Non-ferrous material.
- E. Fan and Motor Assembly:
1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Materials: Non-ferrous components or ferrous components with corrosion resistant finish.
 - d. Statically and dynamically balanced.
 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
 5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
 2. Efficiency: ASHRAE 52.2, MERV 8.
 3. Media:
 - a. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Unit Accessories:
1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
- H. Unit Controls:

1. Enclosure: Metal, suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:
 - a. Unit inlet air temperature.
 - b. Coil entering refrigerant temperature.
 - c. Coil leaving refrigerant temperature.
4. Features and Functions:
 - a. Self-diagnostics.
 - b. Time delay, auto-restart.
 - c. External static pressure control.
 - d. Auto operation mode.
 - e. Manual operation mode.
 - f. Filter service notification.
 - g. Power consumption display.
 - h. Drain assembly high water level safety shutdown and notification.
 - i. Run test switch.
5. Communication: Network communication with other indoor units and outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

I. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
2. Field Connection: Single point connection to power unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways.

2.6 INDOOR, EXPOSED, WALL-MOUNTED UNITS

- A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
- B. Cabinet:
1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
 3. Mounting: Manufacturer-designed provisions for field installation.
 4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Gravity.
 - a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.
3. Field Piping Connection: Non-ferrous material with threaded NPT.

E. Fan and Motor Assembly:

1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
 - d. Wheels statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Front, to accommodate filter replacement without the need for tools.
2. Washable Media: Manufacturer's standard filter with antimicrobial treatment.

G. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.

H. Unit Accessories:

1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.

I. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Features and Functions: Self-diagnostics, time delay, auto-restart.
4. Communication: Network communication with other indoor units and outdoor unit(s).
5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

J. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

2.7 INDOOR, RECESSED, CEILING-MOUNTED UNITS

- A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.

2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
 3. Field Piping Connection: Non-ferrous material.
- E. Fan and Motor Assembly:
1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
 - d. Wheels statically and dynamically balanced.
 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
 5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Bottom, to accommodate filter replacement without the need for tools.
 2. Media:
 - a. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.
1. Discharge Pattern: One-, two-, three-, or four-way throw as indicated on Drawings.
- H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.
- I. Unit Accessories:
1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
 2. Condensate pump.
- J. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 2. Factory-Installed Controller: Configurable digital control.
 3. Features and Functions: Self-diagnostics, time delay, auto-restart.
 4. Communication: Network communication with other indoor units and outdoor unit(s).
 5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- K. Unit Electrical:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 2. Field Connection: Single point connection to power entire unit and integral controls.

3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

2.8 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
1. Specially designed for use in systems with simultaneous heating and cooling.
 2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
 3. All units installed shall be from the same product development generation.
- B. Cabinet:
1. Galvanized steel and coated with a corrosion-resistant finish.
 - a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.
 2. Mounting: Manufacturer-designed provisions for field installation.
 3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Compressor and Motor Assembly:
1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 20 percent of rated capacity.
 2. Protection: Integral protection against the following:
 - a. High refrigerant pressure.
 - b. Low oil level.
 - c. High oil temperature.
 - d. Thermal and overload.
 - e. Voltage fluctuations.
 - f. Phase failure and phase reversal.
 - g. Short cycling.
 3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
 4. Vibration Control: Integral isolation to dampen vibration transmission.
 5. Oil management system to ensure safe and proper lubrication over entire operating range.
 6. Crankcase heaters with integral control to maintain safe operating temperature.
 7. Fusible plug.
- D. Condenser Coil Assembly:

1. Plate Fin Coils:
 - a. Casing: Aluminum, galvanized, or stainless steel.
 - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
 - c. Tubes: Copper, of diameter and thickness required by performance.
 2. Aluminum Microchannel Coils:
 - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
 - b. Single- or multiple-pass arrangement.
 - c. Construct fins, tubes, and header manifolds of aluminum alloy.
 3. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
1. Fan(s): Propeller type.
 - a. Direct-drive arrangement.
 - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
 - c. Statically and dynamically balanced.
 2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
 3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
 4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
 6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
 2. Factory-Installed Controller: Configurable digital control.
 3. Factory-Installed Sensors:
 - a. Refrigerant suction temperature.
 - b. Refrigerant discharge temperature.
 - c. Outdoor air temperature.
 - d. Refrigerant high pressure.
 - e. Refrigerant low pressure.
 - f. Oil level.
 4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, equalize run time between multiple same components.
 5. Communication: Network communication with indoor units and other outdoor unit(s).

6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

H. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 1000 hours according to ASTM B117.

J. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.9 HEAT RECOVERY CONTROL UNITS (HRCUs)

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.

B. Cabinet:

1. Galvanized-steel construction.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

- C. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

D. Refrigeration Assemblies and Specialties:

1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.
2. Each refrigerant branch circuit shall have refrigerant control valve(s) to control refrigerant flow.
3. Spares: Each heat recovery control unit shall include at least one branch circuit port(s) for future use.
4. Each system piping connection upstream of heat recovery unit shall be fitted with an isolation valve to allow for service to any heat recovery control unit in the system without interrupting operation of the system.
5. Each branch circuit connection shall be fitted with an isolation valve and capped service port to allow for service to any individual branch circuit without interrupting operation of the system.
 - a. If not available as an integral part of the heat recovery control unit, isolation valves shall be field installed adjacent to the unit pipe connection.

E. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Features and Functions: Self-diagnostics, fuse protection.
4. Communication: Network communication with indoor units and outdoor unit(s).
5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

F. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

G. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.10 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units, HRCUs, and outdoor units shall include integral controls and connect through a manufacturer-selected control network.

2. Network Communication Protocol: open control communication between interconnected units.

B. VRF HVAC System Operator Software for PC:

1. Software offered by VRF HVAC system manufacturer shall provide system operators with ability to monitor and control VRF HVAC system(s) from a single dedicated Owner-furnished PC.
2. Software shall provide operator with a graphic user interface to allow monitoring and control of multiple central controllers from a single device location through point-and-click mouse exchange.
3. Plan views shall show building plans with location of indoor units and identification superimposed on plans.
4. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
5. Schedules operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Schedules daily, weekly, and annual events.
6. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
7. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
8. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
9. Supports Multiple Languages: English.
10. Supports Imperial and Metric Temperature Units: Fahrenheit.
11. Displays service notifications and error codes.
12. Monitors and displays up to 3000 item error history and 10000 item operation history for regular reporting and further archiving.
13. Monitors and displays cumulative operating time of indoor units.
14. Able to disable and enable operation of individual controllers for indoor units.
15. Information displayed on individual controllers shall also be available for display.
16. Information displayed for outdoor units, including refrigerant high and low pressures.

C. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.
 - a. Include multiple interconnected controllers as required.
2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
 - a. Sets schedule for daily, weekly, and annual events.
 - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.

6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.
9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures **[percent capacity] <Insert outdoor unit displays>**.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel **[and web accessible through standard web browser software]**.

D. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.
2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. Multiple Language: English.
4. Temperature Units: Fahrenheit.
5. On/Off: Turns indoor unit on or off.
6. Hold: Hold operation settings until hold is released.
7. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
8. Temperature Display: 1-degree increments.
9. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between.
10. Relative Humidity Display: 1 percent increments.
11. Relative Humidity Set-Point: Adjustable in 1 percent increments between.
12. Fan Speed Setting: Select between available options furnished with the unit.
13. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
14. Seven-day programmable operating schedule with up to eight events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
15. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
16. Occupancy detection.
17. Service Notification Display: "Filter".
18. Service Run Tests: Limit use by service personnel to troubleshoot operation.
19. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
20. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
21. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
22. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

2.11 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, Class A1 refrigerant classification.
3. R-454b.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.12 SYSTEM CONDENSATE DRAIN PIPING

- A. If more than one material is listed, material selection is Contractor's option.
- B. Copper Tubing:
 1. Drawn-Temper Tubing: According to ASTM B88, Type L.
 2. Wrought-Copper Fittings: ASME B16.22.
 3. Wrought-Copper Unions: ASME B16.22.
 4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.
- C. CPVC plastic pipe according to ASTM F441/F441M, Schedule 40, with socket-type pipe fittings according to ASTM F438 and solvent cement according to ASTM F493.
- D. PVC plastic pipe according to ASTM D1785, Schedule 40, with socket-type pipe fittings according to ASTM D2466 and solvent cement according to ASTM D2564, primer according to ASTM F656.

2.13 SYSTEM REFRIGERANT PIPING

- A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.
- B. Refrigerant Piping:
 1. Copper Tube: ASTM B280, Type ACR.
 2. Wrought-Copper Fittings: ASME B16.22.
 3. Brazing Filler Metals: AWS A5.8/A5.8M.
- C. Refrigerant Tubing Kits:
 1. Furnished by VRF HVAC system manufacturer.
 2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
 3. Standard one-piece length for connecting to indoor units.
 4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
 5. Factory Charge: nitrogen.
- D. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.
- E. Refrigerant Isolation Ball Valves:
 1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
 2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.

3. Valve Connections: Flare or sweat depending on size.

2.14 SYSTEM CONTROL CABLE AND RACEWAYS

- A. Low-Voltage Control Cabling:
 1. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
- B. TIA-485A Network Cabling:
 1. Standard Cable: NFPA 70, Type CMG.
 2. Plenum-Rated Cable: NFPA 70, Type CMP.
- C. Ethernet Network Cabling: TIA-568-C.2 Category **6** cable with RJ-45 connectors.
- D. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for control wiring and cable raceways.

2.15 MATERIALS

- A. Steel:
 1. ASTM A36/A36M for carbon structural steel.
 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 1. Manufacturer's standard grade for casing.
 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.

2.16 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Clearance:
 1. Maintain manufacturer's recommended clearances for service and maintenance.

2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
 1. Loose components shall be installed by system Installer under supervision of manufacturer's service representative.
- C. Indoor Unit Installations:
 1. Install units to be level and plumb while providing a neat and finished appearance.
 2. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of **3/8 inch (10 mm)**.
 3. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
 4. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
 5. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
 6. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
 7. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.
 8. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
- D. Outdoor Unit Installations:
 1. Install units to be level and plumb while providing a neat and finished appearance.
 2. Roof-Mounted Installations: Install outdoor units on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, stainless-steel fasteners.

3.2 GENERAL REQUIREMENTS FOR PIPING AND TUBING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.

- H. Install fittings for changes in direction and branch connections.
- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 CONDENSATE DRAIN PIPE AND TUBING INSTALLATION

- A. General Requirements for Drain Piping and Tubing:
 - 1. Install a union in piping at each threaded unit connection.
 - 2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
 - 3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
 - a. Details indicated on Drawings.
 - b. Manufacturer's requirements.
 - c. Governing codes.
 - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
 - 4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
 - 5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.
- B. Gravity Drains:
 - 1. Slope piping from unit connection toward drain termination at a constant slope of not less than two percent.
- C. Pumped Drains:
 - 1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.4 REFRIGERANT PIPING AND TUBING INSTALLATION

- A. Refrigerant Tubing Kits:
 - 1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.

2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet. Minimum rod size, 1/4 inch.
 3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.
- B. Install refrigerant piping according to ASHRAE 15 and governing codes.
- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Install traps to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.
- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- K. Joint Construction:
1. Ream ends of tubes and remove burrs.
 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
 3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
 - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
 - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.
- 3.5 FIRESTOPPING
- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of manufacturer's service representative:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Refrigerant Tubing Positive Pressure Testing:
1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
 2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.5 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
 5. Submit test reports for Project record.
- C. Refrigerant Tubing Evacuation Testing:
1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
 2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.

- d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
5. Submit test reports for Project record.
 6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.
- D. System Refrigerant Charge:
1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
 2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
 3. System refrigerant charging shall be witnessed by system manufacturer's representative.
 4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.
- E. Products will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.
1. Service representative shall be an employee of VRF HVAC system manufacturer.
 2. Complete startup service of each separate system.
 3. Complete system startup service according to manufacturer's written instructions.
- B. Startup checks shall include, but not be limited to, the following:
1. Check control communications of equipment and each operating component in system(s).
 2. Check each indoor unit's response to demand for cooling and heating.
 3. Check each indoor unit's response to changes in airflow settings.
 4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
 5. Check sound levels of each indoor and outdoor unit.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
3. Manufacturer shall electronically record not less than **[two]** **<Insert number>** hours of continuous operation of each system and submit with report for historical reference.
 - a. All available system operating parameters shall be included in the information submitted.

E. Witness:

1. Invite Owner to witness startup service procedures.
2. Provide written notice not less than 10 business days before start of startup service.

3.8 ADJUSTING

- A. Adjust equipment and components to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
- C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.
- D. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

- A. Engage a VRF HVAC system manufacturer's employed training instructor to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

END OF SECTION 238129

SECTION 238239.19
WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko; Marley Engineered Products.
2. Chromalox, Inc.
3. INDEECO.
4. Marley Engineered Products.
5. QMark; Marley Engineered Products.

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's custom color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

- A. Controls: Unit-mounted thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

2.7 CAPACITIES AND CHARACTERISTICS

1. SEE SCHEDULE ON DRAWINGS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

SECTION 260010

SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements applicable to Work specified in Division 26.

B. Related Requirements:

1. Section 260501 "Basic Electrical requirements" for additional scope and requirements.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure (Note: not all abbreviations may be used and do not allow specific materials to be substituted in place of later specifications sections):

1. 8PSJ or 8P8C: Miniature 8-position series jack, also called an 8-position 8-contact modular jack for some applications.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. CO/ALR: Copper-aluminum, revised.
17. COPS: Critical operations power system.
18. CU or Cu: Copper.
19. CU-AL or AL-CU: Copper-aluminum.
20. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
21. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
22. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
23. dBm: Decibel absolute power with respect to 1 mW.
24. DC or dc: Direct current.
25. DCOA: Designated critical operations area.
26. DDC: Direct digital control (HVAC).

27. EGC: Equipment grounding conductor.
28. EMF: Electromotive force.
29. EMI: Electromagnetic interference.
30. EPM: Electrical preventive maintenance.
31. EPS: Emergency power supply.
32. EPSS: Emergency power supply system.
33. ESS: Energy storage system.
34. EV: Electric vehicle.
35. EVPE: Electric vehicle power export equipment.
36. EVSE: Electric vehicle supply equipment.
37. fc: Footcandle, a unit of illuminance equal to one lumen per square foot.
38. FLC: Full-load current.
39. ft.: Foot.
40. GEC: Grounding electrode conductor.
41. GFCI: Ground-fault circuit interrupter.
42. GFPE: Ground-fault protection of equipment.
43. GND: Ground.
44. HACR: Heating, air conditioning, and refrigeration.
45. HDPE: High-density polyethylene.
46. HID: High-intensity discharge.
47. HP or hp: Horsepower.
48. HVAC: Heating, ventilating, and air conditioning.
49. Hz: Hertz.
50. IBT: Intersystem bonding termination.
51. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
52. IP: Ingress protection rating (enclosures); Internet protocol (communications).
53. IR: Infrared.
54. IS: Intrinsically safe.
55. IT&R: Inspecting, testing, and repair.
56. ITE: Information technology equipment.
57. kAIC: Kiloampere interrupting capacity.
58. kcmil or MCM: One thousand circular mils.
59. kV: Kilovolt.
60. kVA: Kilovolt-ampere.
61. kVA_r or kVAR: Kilovolt-ampere reactive.
62. kW: Kilowatt.
63. kWh: Kilowatt-hour.
64. LAN: Local area network.
65. lb: Pound (weight).
66. LCD: Liquid-crystal display.
67. LCDI: Leakage-current detector-interrupter.
68. LED: Light-emitting diode.
69. LNG: Liquefied natural gas.
70. LP-Gas: Liquefied petroleum gas.
71. LRC: Locked-rotor current.
72. MCC: Motor-control center.
73. MDC: Modular data center.
74. MG set: Motor-generator set.
75. MIDI: Musical instrument digital interface.
76. MLO: Main lugs only.
77. MVA: Megavolt-ampere.
78. mW: Milliwatt.
79. MW: Megawatt.
80. MWh: Megawatt-hour.
81. NC: Normally closed.
82. NiCd: Nickel cadmium.

83. NIU: Network interface unit.
84. NO: Normally open.
85. NPT: National (American) standard pipe taper.
86. OCPD: Overcurrent protective device.
87. ONT: Optical network terminal.
88. PC: Personal computer.
89. PCS: Power conversion system.
90. PCU: Power-conditioning unit.
91. PF or pf: Power factor.
92. PHEV: Plug-in hybrid electric vehicle.
93. PLC: Programmable logic controller.
94. PLFA: Power-limited fire alarm.
95. PoE: Power over Ethernet.
96. PV: Photovoltaic.
97. PVC: Polyvinyl chloride.
98. pW: Picowatt.
99. RFI: Radio-frequency interference (electrical); Request for interpretation (contract).
100. RMS or rms: Root-mean-square.
101. RPM or rpm: Revolutions per minute.
102. SCADA: Supervisory control and data acquisition.
103. SCR: Silicon-controlled rectifier.
104. SPD: Surge protective device.
105. sq.: Square.
106. SWD: Switching duty.
107. TCP/IP: Transmission control protocol/Internet protocol.
108. TEFC: Totally enclosed fan-cooled.
109. TR: Tamper resistant.
110. TVSS: Transient voltage surge suppressor.
111. UL: Underwriters Laboratories, Inc. (standards) or UL LLC (services).
112. UL CCN: UL Category Control Number.
113. UPS: Uninterruptible power supply.
114. USB: Universal serial bus.
115. UV: Ultraviolet.
116. V: Volt, unit of electromotive force.
117. V(ac): Volt, alternating current.
118. V(dc): Volt, direct current.
119. VA: Volt-ampere, unit of complex electrical power.
120. VAR: Volt-ampere reactive, unit of reactive electrical power.
121. VFC: Variable-frequency controller.
122. VOM: Volt-ohm-multimeter.
123. VPN: Virtual private network.
124. VRLA: Valve-regulated lead acid.
125. W: Watt, unit of real electrical power.
126. Wh: Watt-hour, unit of electrical energy usage.
127. WPT: Wireless power transfer.
128. WPTE: Wireless power transfer equipment.
129. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit.

7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
9. EPEC-A: Type A electrical HDPE underground conduit.
10. EPEC-B: Type B electrical HDPE underground conduit.
11. ERM: Electrical rigid metal conduit.
12. ERM-A: Aluminum electrical rigid metal conduit.
13. ERM-S: Steel electrical rigid metal conduit.
14. ERM-S-G: Galvanized-steel electrical rigid metal conduit.
15. ERM-S-PVC: PVC-coated-steel electrical rigid metal conduit.
16. ERM-SS: Stainless steel electrical rigid metal conduit.
17. FMC: Flexible metal conduit.
18. FMC-A: Aluminum flexible metal conduit.
19. FMC-S: Steel flexible metal conduit.
20. FMT: Steel flexible metallic tubing.
21. FNMC: Flexible nonmetallic conduit. See LFNC.
22. HDPE: See EPEC.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERM-S-G.
38. RMC: See ERM.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.

13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: Moisture-, heat-, and oil-resistant thermoplastic cable (machine tool wiring).
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: Thermoset rubber, heat-resistant cable (high heat).
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.

- 68. TW: Thermoplastic, moisture-resistant cable.
- 69. UF: Underground feeder and branch-circuit cable.
- 70. USE: Underground service-entrance cable.
- 71. XHH: Cross-linked polyethylene, heat-resistant cable.
- 72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

- 1. Basic Impulse Insulation Level: Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
- 2. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
- 3. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
- 4. Designated Seismic System: A system component that requires design in accordance with ASCE/SEI 7, Ch. 13 and for which the Component Importance Factor is greater than 1.0.
- 5. Direct Buried: Installed underground without encasement in concrete or other protective material.
- 6. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.

- n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - o. Raised-Floor Box: A floor box intended for use in raised floors.
 - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
- 7. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
 - 8. Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. (healthcare facilities)
 - 9. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
 - 10. Jacket: A continuous nonmetallic outer covering for conductors or cables.
 - 11. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
 - 12. Miniature 8-Position Series Jack (8PSJ): Also called an 8-position 8-contact (8P8C) modular jack. An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Shape and dimensions are specified by TIA-1096.
 - a. Caution: An 8PSJ is not the same thing as an FCC "registered jack" RJ45S, now called a miniature 8-position keyed jack (8PKJ). Ethernet cable plugs do not have rejection keys. Many manufacturers and suppliers incorrectly use "RJ45" as a generic term to describe any 8-position series plug or jack whether it has a rejection key or not.
 - 13. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
 - 14. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
 - 15. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
 - 16. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
 - 17. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
 - 18. Sheath: A continuous metallic covering for conductors or cables.
 - 19. UL Category Control Number: An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
 - 20. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

- a. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by Class 2 or Class 3 power supplies having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
- b. Low Voltage: Listed and labeled for use in circuits supplied by Class 1 or other power supplies having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.
- c. Medium Voltage: Listed and labeled for use in circuits supplied by a power supply having rated output greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Parts I and II.

1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.
 - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.
 - c. Elevators.
 - d. Fire-alarm systems.
- B. Arrange to provide temporary electrical service in accordance with requirements specified in Division 01.

1.4 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
 - 1. Electrical installation schedule.
 - 2. Status of power system studies.
 - 3. Value analysis proposals and requests for substitution of electrical equipment.
 - 4. Utility work coordination and class of service requests.
 - 5. Commissioning activities.
 - 6. Sustainability activities.

1.5 SEQUENCING

- A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.6 ACTION SUBMITTALS

- A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.
- B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which equipment and suspension systems will be attached.
 - 3. Size and location of access panels on ceilings.
 - 4. Elevation, size, and route of sprinkler piping.
 - 5. Elevation, size, and route of plumbing piping.
 - 6. Elevation, size, and route of ductwork.
 - 7. Elevation, size, and route of cable tray.
 - 8. Elevation, size, and route of conduit.
 - 9. Elevation and size of wall-mounted and ceiling-mounted equipment.
 - 10. Access panels.
 - 11. Sprinklers.
 - 12. Air inlets and outlets.
 - 13. Control modules.
 - 14. Luminaires.
 - 15. Communications devices.
 - 16. Speakers.
 - 17. Security devices.
 - 18. Fire-alarm devices.
 - 19. Indicate clear dimensions for maintenance access in front of equipment.
 - 20. Indicate dimensions of fully-open access doors.
- C. Coordination Drawings for Cable Tray Routing: Reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Elevation, size, and route of cable trays.
 - 2. Relationships between components and adjacent structural, electrical, and mechanical elements.
 - 3. Vertical and horizontal offsets and transitions.
 - 4. Elevation and size of sleeves for wall, ceiling, and floor cable penetrations.
 - 5. Elevation of ceilings and size of ceiling tiles.
 - 6. Locations of access panels on ceilings.
 - 7. Locations where cable tray crosses or parallels sprinkler piping.
 - 8. Locations where cable tray crosses plumbing piping.
 - 9. Locations where cable tray crosses or parallels ductwork.
 - 10. Locations of access panels on ductwork.
 - 11. Locations where cable tray crosses conduit.
 - 12. Items blocking access around cable trays, including the following:
 - a. Light fixtures.
 - b. Speakers.
 - c. Fire-alarm devices.
 - d. Power outlets.
 - e. Wall-mounted equipment.

- f. Equipment racks.
 - g. Furniture.
 - h. Door swings.
 - i. Building features.
- 13. Indicate clear dimension between cable tray and walls or obstructions that are closer than 10 ft. (3 m).
- 14. Highlight locations where cable tray is greater than 3 ft. (1 m) above ceilings. Explain how personnel access will be accommodated for cable tray maintenance.
- D. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- E. Coordination Drawings for Bus Assembly Routing: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements.
 - 2. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
 - 3. Clearances for access above and to the side of enclosed bus assemblies.
 - 4. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
 - 5. Support locations, type of support, and weight on each support.
 - 6. Location of adjacent construction elements including luminaires, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.
- F. Coordination Drawings for Large Equipment Indoor Installations:
 - 1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
 - 2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
 - b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
 - c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.
 - 3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.

- b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
- c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.

G. Coordination Drawings for Large Equipment Outdoor Installations:

- 1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
 - b. Indicate clear dimensions for fence gates and wall openings.
 - c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
 - d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
 - e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
 - f. Dimensioned working clearances and dedicated areas around electrical equipment.

H. Coordination Drawings for Duct Banks: Signed and sealed by qualified professional engineer.

- 1. Show duct profiles and coordination with other utilities and underground structures.
- 2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.7 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

- 1. Submission of power system studies.
- 2. Submission of specified coordination drawings.
- 3. Submission of action submittals specified in Division 26.
- 4. Orders placed for major electrical equipment.
- 5. Arrival of major electrical equipment on-site.
- 6. Preinstallation meetings specified in Division 26.
- 7. Utility service outages.
- 8. Utility service inspection and activation.
- 9. Mockup reviews.
- 10. Closing of walls and ceilings containing electrical Work.
- 11. System startup, testing, and commissioning activities for major electrical equipment.
- 12. System startup, testing, and commissioning activities for emergency lighting.
- 13. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
- 14. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
- 15. Requests for special inspections.
- 16. Requests for inspections by authorities having jurisdiction.

- B. Delegated Design Drawings for Structural Masonry Wall Penetrations: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by elevations, sections, and other details, drawn to scale, signed and sealed by a qualified structural professional engineer, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Location and dimensions of structural members supporting wall.
 - 2. Location and dimensions of columns near penetrations.
 - 3. Location and dimension of headers and lintels.
 - 4. Doors and windows near penetrations.
 - 5. Location and dimensions of penetrating cuts.
 - 6. Sprinkler piping and sleeves.
 - 7. Plumbing piping and sleeves.
 - 8. Ductwork and sleeves.
 - 9. Cable tray and sleeves.
 - 10. Conduit and sleeves.
 - 11. Firestopping assemblies for rated penetrations.
 - 12. Structural supports for piping, ductwork, and conduit on both sides of wall.
- C. Certificates:
 - 1. Welding certificates.
- D. Qualification Statements:
 - 1. For qualified regional manufacturer.
 - 2. For structural professional engineer.
 - 3. For electrical professional engineer.
 - 4. For lighting professional engineer.
 - 5. For EPM specialist.
 - 6. For welder.
 - 7. For ERMC-S-PVC raceway Installer.
 - 8. For generator set Installer.
 - 9. For lighting testing and inspecting agency.

1.8 CLOSEOUT SUBMITTALS

- A. Facility EPM Program Binders:
 - 1. Complete Set: On approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
 - 2. Volumes 2 and 8: Reproducible hardcopy on archival quality, 28 lb, acid-free, bond paper.
- B. Operation and Maintenance Data:
 - 1. Refer to Section 260501 "Basic Electrical Requirements".
- C. Software and Firmware Operational Documentation: Provide software and firmware operational documentation in Facility EPM Program Binders, including the following:
 - 1. Software operating and upgrade manuals.
 - 2. Names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

5. Testing and adjusting of panic and emergency power features.
6. For lighting controls include the following:
 - a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
 - b. Operation of adjustable zone controls.

D. Software:

1. Program Software Backup: Provide username and password for approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
2. Provide to Owner upgrades and unrestricted licenses for Government use for installed and backup software, including operating systems and programming tools required for operation and maintenance.

1.9 QUALIFICATIONS

- A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.
- B. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering.
- C. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
- D. Lighting Professional Engineer: Professional engineer possessing active qualifications in accordance with Section 014000 "Quality Requirements" and the following:
 1. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
 2. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).
- E. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.
- F. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

1.10 MOCKUPS

- A. Simple Mockups for Coordinating Accessibility of Electrical Devices around Fixed Furnishings and Equipment:
 1. Build simple mockups using art supplies and other inexpensive materials for verification of general arrangement, actual dimensions, and accessibility of electrical equipment and/or devices by Architect prior to fabrication and installation of Work. Depict products from all

Divisions requiring coordination including, but not limited to, fixed furnishings, casework, outlet covers and plates, HVAC controls, exposed raceway, exposed plumbing, equipment, and signage.

- B. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.11 FIELD CONDITIONS

- A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260010

SECTION 260501
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 GENERAL REQUIREMENTS

- A. Applicable requirements of the Contract Documents, preceding the Technical Specifications, apply to this Section. In the event of conflict between the Specifications, the most stringent shall apply.
- B. Separation of these Specifications into Divisions and Sections is for convenience only and is not intended to establish limits of work.
- C. Consult index to be certain that set of Documents and Specifications is complete. Report omissions or discrepancies to the Owner's Representative.
- D. The Contractor shall employ high standards of good workmanship and shall pay special attention to the safety of personnel and equipment. The installation of material and equipment shall be in conformance with the latest edition of all codes and standards, as adopted by the local authority having jurisdiction, including those listed in Paragraph: STANDARDS. The agency having the most stringent requirements shall be adhered to.
- E. The Contractor shall make a thorough examination of the site and shall make due allowances for difficulties and contingencies to be encountered. All dimensions shall be checked and verified by the Contractor at the site.
- F. The Contractor and all Sub-Contractors shall have a minimum of three years proven experience on projects with similar levels of complexity and magnitude. Experience shall be based on the experience as a company and not on the experience as individuals.
- G. The Drawings and Specifications are intended to function as a common set of documents. Anything shown on the Drawings but not mentioned in the Specifications or mentioned in the Specifications and not shown on the Drawings, shall be equally binding as if both noted on the Drawings and called for in the Specifications.

1.3 OWNER'S REPRESENTATIVE

- A. The Owner's Representative is the person appointed by the Owner. The Owner's Representative will advise and consult with the Owner during construction and until final payment is due. The Owner's instructions to the Contractor shall be forwarded through the Owner's Representative.

1.4 SCOPE

- A. The work covered by and included in these Specifications consists of the furnishing of all materials, all equipment, labor, tools and supervision and performing all operations necessary for the proper and complete execution of the Electrical work in strict accordance with the Specifications and the Drawings and subject to the terms and conditions of the Contract.
- B. Unless noted otherwise, this Contractor shall furnish and install all control devices together with control wiring, conduit and all appurtenances and accessories necessary to perform the operating functions as specified. Control devices shall include, but not be limited to, thermostats, switching relays, control relays and transformers. Wiring materials and installation shall conform to the National Electric Code. All control system wiring shall be 14 AWG minimum installed in 1/2 inch diameter minimum conduit.
- C. It is the intent of these Drawings and Specifications to provide complete and fully functional systems unless otherwise indicated. The Contractor shall provide all incidental components (locknuts, screws, washers, etc.) required to accomplish this intent. This shall include furnishing devices which are obviously required by the design intent such as the second three-way switch where one such switch is shown, fuses for fused disconnect switches, etc.
 - 1. Contractor shall review the drawings and is required to prepare request for information (RFI) questions for any discrepancies or if portions of systems as shown and it is unclear what is to be provided prior to submitting bid. If a system is shown and no RFI is presented, Contractor will provide a full system and components to ensure that the entire system is functioning properly.

1.5 DEFINITIONS

- A. The term "Contractor" or "Electrical Contractor" when used in this Specification refers to the Contractor responsible for all work under this Section.
- B. The term "Provide" refers to this Contractor purchasing, delivering and installing as a part of this Contract.

1.6 STANDARDS

- A. NFPA 70 National Electrical Code (NEC).
- B. NFPA 72 National Fire Alarm Code.
- C. NFPA 101 Code for Safety to Life from Fire in Buildings and Structures.
- D. Pennsylvania Act 45, Uniform Construction Code (UCC).
- E. Underwriters Laboratories Electrical Construction Materials Directory.

- F. International Building Code (IBC).
- G. Public Law 101-336, The Americans with Disabilities Act of 1990.
- H. ASTM B-8 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.
- I. ASTM B-496 Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
- J. ICEA S-95-658/NEMA WC70 Non-Shielded 0-2 KV Cables.
- K. NETA ATS acceptance testing specifications for electrical power distribution equipment and systems.

1.7 NOTIFICATION

- A. Trades that have work connected with the Electrical work and trades that do preparatory work for electrical equipment shall be notified for installation requirements and scheduling.
- B. The Owner's Representative shall be informed of the installation schedule to allow sufficient time for inspection without any work delay.
- C. All work shall be coordinated to avoid cutting of work in place and interfering with other operations.
- D. In compliance with Act 38, contact individual companies to have utility locations marked in the field and to otherwise locate underground objects as may be necessary prior to the start of construction.
 - 1. Pennsylvania law requires three working days notice for the construction phase and ten working days in design stage. Call Pennsylvania One Call System, Inc. (1-800-242-1776, as of this writing).

1.8 CONTRACT DRAWINGS

- A. The Contract Drawings are diagrammatic and indicate relation of conduits, connections and equipment. Vendor catalog numbers do not necessarily indicate trim and fitting requirements. Drawings do not indicate all boxes and fittings that may be required. Therefore, the Contractor shall carefully investigate structural and finish conditions affecting work. The Contractor shall furnish all boxes, fittings, hangers and accessories as may be required to meet these conditions at no additional cost to the Owner.
- B. Do not scale the Drawings. The Contractor shall check conditions at the site for dimensions and sizes pertaining to the structure.
- C. Do not deviate from the Drawings without prior written approval.

1.9 LINES, GRADE AND SURVEYS

- A. All necessary surveys, lines, grades and measurements are the responsibility of the Contractor desiring the information for the proper installation of his work. The Contractor is responsible for the proper installation of the work with respect to other Contractors.

- B. Grades, elevations and locations shown on the Drawings are approximate and the Contractor shall check all such information on the site before proceeding with the work

1.10 WORKMANSHIP

- A. All equipment, conduit, fixtures, etc. shall be installed in a workmanlike manner meeting the accepted standards of the representative industry.
- B. All work to be performed shall be done by qualified mechanics. All mechanics in the employ of this Contractor on this project shall be skilled in the phases of the work to which they are used. The mechanic's affiliation with labor organizations shall be acceptable to all trades employed on the project.

1.11 CUTTING AND PATCHING

- A. In new construction, the Contractor shall give the General Contractor complete information as to size of openings required in floors and walls, etc., so that such openings may be provided as the project progresses. In existing construction, the Contractor shall do his own cutting and patching required for the installation of his work.
- B. If openings are omitted or are incorrect through failure of the Contractor to follow these instructions, the Contractor shall, at his own expense, engage the trade, which originally installed the work, to cut and patch to the satisfaction of the Owner's Representative
- C. All cutting and patching of every nature required in connection with this Contract shall be done by the Contractor with mechanics experienced in their respective lines of work. All patching shall match adjacent finishes.
- D. All cutting in building shall be done with great care so as not to leave an unsightly surface, which may not be concealed by plates, escutcheons, or other normal concealing construction. If such unsightly conditions occur the Contractor shall be required at his own expense, to engage the General Contractor to replace the damaged materials with new materials.
- E. Any penetrations of a roof shall be done in accordance with the roof manufacturer's recommended details for that type of roof and per industry recognized good practices. The penetration methods shall not invalidate any existing warranties.

1.12 CONCRETE AND MASONRY WORK.

- A. Unless otherwise noted, all concrete bases, reinforcing, etc. and masonry work required to install the respective Contract Work shall be furnished and installed by the respective Contractor.
- B. Provide a 3-1/2 inch high housekeeping pad for all substations, switchboards, motor control centers, transformers, power converters, and other floor mounted equipment. Pads shall extend one inch in all directions beyond the edge of the equipment.
- C. The Contractor shall furnish all materials, labor, equipment and tools necessary to complete concrete and cement work.
- D. All concrete work shall comply with the requirements of the ACI Building Code (ACI 318), the ACI Detailing Manual (ACI 315) and the Specifications for Structural Concrete for Buildings (ACI 301).

- E. All reinforcing steel shall be manufactured from high strength billet steel conforming to ASTM Designation A-615 Grade 60. Welded-wire fabric shall comply with ASTM A-185

1.13 MATERIALS

- A. All materials and equipment provided by this Contractor shall be new, without imperfections and blemishes and shall be protected from the elements prior to installation in building.
- B. All equipment shall meet the requirements of NFPA 70 and, in addition, shall be tested, listed and labeled by an approved authority (UL) and shall be installed in accordance with its listing. The Owner's Representative shall have full authority to reject any equipment, material or installation of same, showing defects of manufacture or workmanship.
- C. All equipment subject to specific requirements of the Owner's insurance company (fire alarm system, security system, etc.) shall meet the insurance company's requirements.

1.14 METHOD

- A. The Electrical Contractor shall confer with all other Contractors and shall apply for detailed and specific information regarding the location of all equipment as the final location may differ from that indicated on the Drawings. Outlets, equipment or wiring improperly placed because of the Electrical Contractor's failure to obtain this information shall be relocated and reinstalled by the Electrical Contractor without additional expense to the Owner
- B. Each Contractor, upon request of the Owner's Representative, shall expedite the work of a specific area, section or part of the project to permit the installation of another part of the work.
- C. All conduits, wire, cable, wiring devices and equipment shall be installed in such a manner as to preserve access with sufficient space provided for proper operation and maintenance to any existing equipment or to any new equipment installed under this Specification or under other Specifications or Contracts for this building.
- D. This Contractor shall coordinate his work with that of other trades so that all work may be installed in the most direct manner and so that interference between piping, ducts, equipment, architectural or structural features will be avoided. If an interference results, the Owner's Representative shall decide which work is to be relocated, regardless of which was first installed. Such relocation shall be at no additional cost to the Owner.
- E. All materials and equipment installed by the Contractor shall be firmly supported and secured to the building construction where required.
- F. All items of labor, material and equipment not specified in detail or shown on the Drawings but incidental to, or necessary for, the complete and proper installation and proper operation of the work described herein or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Specifications or Drawings.
- G. All equipment shall be installed in accordance with the manufacturer's recommendations and installation instructions. The manufacturer's installation recommendations and instructions shall be considered part of the Contract.
- H. The equipment installation shall also adhere to the installation recommendations and instructions of other building components such as wall and roof materials which the installation impacts.

- I. Any questions regarding means or methods of construction shall be addressed during the bidding phase of the project.

1.15 SCHEDULING OF WORK

- A. The Contractor shall attend all planning meetings, provide scheduling information and work with all trades to obtain a workable project schedule that meets the Owner's requirements.

1.16 PROTECTION

- A. Each Contractor shall effectively protect his work and materials with tarpaulins or heavy plastic material against dirt, water, chemicals, plaster, or damage during the entire period of installation or until he is directed to remove the coverings by the Owner's Representative. Any damaged material must be removed and replaced by the Contractor without additional cost regardless of the cause of the damage. All openings in conduit, fittings, etc., must be effectively sealed to exclude dirt, sand and other foreign substances.

1.17 PROTECTION OF OWNER'S EQUIPMENT

- A. The Contractor shall provide any temporary work required to protect the Owner's equipment and to contain the dust generated during construction. Any measures taken by the Contractor for the protection of equipment shall be installed to the satisfaction of the Owner or Owner's Representative, which may include any and all provisions listed in DIVISION-1 General Requirements and/or in accordance with the appropriate technical specifications for wood and plastics in DIVISION-6. An approved protection material is nylon reinforced flame retardant and anti-static Griffolyn T-55 ASFR 6 mil film (1-800-231-6074 - as of this writing).

1.18 RUBBISH REMOVAL AND CLEAN UP

- A. Each Contractor is responsible for periodic removal of all rubbish resulting from his work. All surplus material, refuse, rubbish, etc., shall be removed from the job site at the completion of the Contract. The Owner's Representative must be satisfied with the removal and clean up.
- B. All rubbish shall be legally disposed of by the Contractor. Rubbish removed from the site shall become the responsibility of the Contractor.
- C. Any hazardous materials discovered which are not included in the contract shall be brought to the Owner's attention prior to removal from the site.

1.19 DELIVERING AND STORAGE OF MATERIALS EQUIPMENT

- A. Deliver accessories, small unmarked parts, adhesives, sealants and incidental items to site in manufacturer's original, unopened, labeled containers
- B. Store materials and equipment to prevent damage and injury. Store ferrous materials to prevent rusting. Store equipment and lighting fixtures to prevent staining and discoloring.

1.20 IDENTIFICATION OF MATERIALS AND EQUIPMENT

- A. All panels, combination motor starters, safety switches, motor operated time switches, junction and pull boxes, in-panel sub-feeders and similar items installed under this project shall be identified by name, function and/or control. Included on nameplates shall be the voltage of the involved circuits. Nameplates shall be at least one by three inch with characters not less than 1/4 inch high. They shall be made up of two laminated black plastic sheets bonded with a middle sheet of white plastic and characters engraved in one black sheet to the depth of the white plastic.
- B. The Contractor shall provide a typewritten indexed directory in each panelboard indicating the item or items controlled by each circuit.
- C. Directories in any existing panelboards shall be updated in typewritten format showing all circuit changes.
- D. All circuits shall be identified in outlet boxes as to the specific circuit connection. All circuit conductors shall also be identified as to the voltage of the circuit.
- E. Color coding shall be as listed in Section "WIRING" of these Specifications.
- F. A typewritten list of nameplates shall be submitted to the Owner's Representative for approval before ordering.

1.21 PAINTING

- A. Where factory finishes are provided and no additional field painting is specified; all marred or damaged surfaces shall be touched up or refinished to a smooth and uniform finish. Provide one-pint quantity of factory finish touch-up paint to the Owner.
- B. All exposed ferrous metalwork, pipe, supports, hangers, insulation and other surfaces not factory painted shall be painted with one prime and two finish coats. Paint, surface preparation and application shall be as specified in the Architectural Section: PAINTING. Colors shall match existing work or shall be as selected by the Owner's Representative.
- C. A quantity of touch-up paint (minimum size - one pint) shall be provided for each color used by the Contractor. Touch-up paint shall be delivered to the Owner.

1.22 LAWS, ORDINANCES, AND REGULATIONS

- A. All systems in all and/or part shall conform to all pertinent laws, ordinances, and regulations of ALL bodies having jurisdiction, at all governing levels. In case of conflict between governing levels, the more stringent law shall apply. As a minimum, all work shall comply with IBC, NFPA, OSHA and USBC requirements.
- B. The Contractor shall pay all fees and prepare and submit all utility applications and obtain and pay for all permits, inspections, and certifications required with his work.
- C. All electrical work shall be inspected and certified by the local authorities; if no local authority inspection is available an independent inspection agency such as the Middle Department Inspection Agency (MDIA) shall be hired by the Contractor.

- D. The Contractor shall make the Owner's Representative aware of any and all code variances that may apply to the electrical equipment/systems. Application for said variances shall be the responsibility of the Owner's Representative.

1.23 BUILDING EXPANSION JOINTS AND FIRE RATED ASSEMBLIES

- A. Provide expansion joints in conduits where they cross building expansion joints.
- B. Where cables or conduits pass through fire rated portion of the structure, the annular space between them and the structure shall be filled with an approved fireproof material.
- C. Meet all requirements of Underwriter's Laboratories and all applicable codes for maintaining the integrity of all fire rated assemblies.
- D. Contractor shall engage the services of a fire protection contractor to review the drawings and install fire protection products to maintain the integrity of all pipe, wire, conduit, etc. penetrations through any and all fire rated walls, floors, barriers, and assemblies. Fire stop training and products shall be 3M or approved equal.

1.24 ACCESS DOORS

- A. The Contractor shall provide access panels/access doors for access to dampers, valves, controllers or any other equipment or component requiring access for maintenance, adjustment or service wherever these items are concealed in building walls, partitions or ceilings. Frames shall be anchored in walls, partitions or ceilings and shall be set true to lines of the building and flush with the finished surfaces. Access panels/access doors shall be as specified in the General Construction Sections of the Specifications.

1.25 FASTENINGS, SUPPORTS, AND HANGERS

- A. Fastenings, supports, hangers, miscellaneous steel, clamps, and anchors shall be made for purpose for which they are to be used. Toggle bolts or machine bolt fastenings shall be used for hollow tile, terra cotta or lath construction; machine screws for structural steel fastenings; lead expansion shields, and machine screws or lag screws for solid masonry fastening; lag screws for wood fastening. All equipment and conduit shall be rigidly and firmly installed to prevent swaying, vibrating or sagging by malleable or wrought steel hangers of standard design, pipe clamps or fabricated steel supports of approved design. Hangers of horizontal conduit runs shall be adjustable clevis type. Perforated strap iron hangers and caddy clips are not permissible.

1.26 SOUND PARTITIONS

- A. Contractor shall be responsible to identify all sound partitions indicated on the architectural plans. Contractor shall seal all penetrations through the wall to maintain the sound absorption integrity of the partition.

1.27 CONCRETE INSERTS

- A. The Electrical Contractor shall provide concrete inserts of an approved carbon steel wedge type for all hangers. Where two or more parallel conduits are installed continuous inserts may be used. Where required to distribute the load on the inserts, a piece of reinforcing steel of sufficient

length shall be passed through the insert. Each insert shall include a knockout piece. Concrete inserts shall have a minimum safety factor of five.

1.28 SLEEVES

- A. The Electrical Contractor shall provide and install sleeves where required to protect equipment or facilities in the installation. Each sleeve shall extend through its respective floor, wall, or partition and shall be cut flush with each surface unless otherwise required.
- B. Sleeves in bearing and masonry walls, floors and partitions shall be of standard weight steel pipe finished with smooth edges. For other masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 U.S.G. galvanized iron.
- C. All sleeves shall be properly installed and securely cemented in place.
- D. Floor sleeves shall extend one inch above the finished floor. Space between floor sleeves and passing conduit shall be caulked with an approved graphite packing and/or waterproof caulking compound.
- E. Where conduits pass through waterproofed floors or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
- F. Where sleeves pass through fire-rated walls or floors, a fire barrier protection system shall be used.
- G. See architectural drawings for fire ratings of building components.

1.29 FIRE STOPPING

- A. The contractor shall be responsible to provide and install fire-stopping materials and/or systems where his work penetrates fire and/or smoke rated portions of the building and non-fire resistance-rated assemblies. All materials used shall be manufactured such that they are intended to resist the spread of fire and the passage of smoke. This includes but is not limited to rated walls, floors, shafts, ceilings, and non-fire resistance-rated horizontal assemblies. All fire stopping materials used shall have a fire resistance rating equal to or greater than the rated assembly for which they are installed.
- B. For locations where the installed fire stopping material is exposed to normal view, the contractor shall conceal the material with chrome-plated escutcheon plates or other materials that have a flame-spread value of 25 or less and a smoke developed rating of 50 or less, as determined per ASTM E 84. The concealing device shall be approved by the owner's representative prior to installation. Provide shop drawings for each device.
- C. The contractor shall provide components/accessories for each fire-stopping system that are needed to install fill materials and to comply with all system performance requirements as recommended by the fire stopping material manufacturer. Accessories include but are not limited to: mineral wool insulation, ceramic fiber, sealants used to aid in the formation of the fire stopping materials, fire-rated formboard, joint fillers and sealers, collars and steel sleeves.
- D. Fire stopping materials and systems shall include, but are not limited to, the following: fire barrier caulk and sealants, intumescent caulk, intumescent putty, intumescent wrap strips, silicone foams and sealants, fire barrier composite sheets and cast-in-place fire barrier systems.

- E. Fire stopping materials and systems shall be as manufactured by 3M Fire Protection Products, Hilti Corporation, or ProSet Systems Inc.

1.30 ANCHOR BOLTS

- A. The Contractor shall provide and set in place, at the time of pouring of concrete foundations, all necessary anchor bolts as required for the equipment called for in these specifications. Anchor bolts shall be of the hook type, of proper size and length to suit the equipment. Anchor bolts shall be set in pipe sleeves of approximately twice the bolt diameter and one half the embedded length of the bolt. The Contractor shall assume full responsibility for proper coordination and placement of the bolts. Upon completion of equipment installation, pipe sleeves shall be caulked in accordance with Section, "SLEEVES" of these Specifications.

1.31 WARRANTY

- A. The systems specified herein shall be guaranteed to be free from defects in workmanship and material under normal use and service for a period of one year from acceptance by the Owner or Owner's Representative.
- B. If, within the aforementioned warranty period, any of the materials specified herein is proven to be defective in any way, it shall be replaced or repaired at no additional cost to the Owner. The warranty shall include the providing of all labor and materials necessary for repair or replacement of any defective components. The Contractor is responsible for the costs of any services required by equipment suppliers that are not included in the suppliers' warranties.
- C. The Contractor shall, after acceptance of the installation by the Owner or the Owner's Representative, provide any service incidental to the proper performance of the system under the warranties outlined above for the time periods listed above.
- D. The Contractor shall be responsible to ensure that his work does not invalidate either wholly or partially any existing warranties or the warranties of material or work performed by others. The Contractor is responsible for the costs to repair damaged work and to re-establish the warranty.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260501

SECTION 260502
SPECIAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 GENERAL REQUIREMENTS

- A. Applicable requirements of the Contract Documents, preceding the Technical Specifications, apply to this Section. In the event of conflict between the Specifications, the most stringent shall apply.

1.3 SCOPE.

- A. The work covered by and included in these Specifications consists of the furnishing of all materials, all equipment, labor, tools and supervision and performing all operations necessary for the proper and complete execution of the Electrical work in strict accordance with the Specifications and the Drawings and subject to the terms and conditions of the Contract.

1.4 WORK IN THE EXISTING BUILDING.

- A. The Electrical Contractor shall be responsible for thoroughly surveying the existing building to determine the extent and cost of installing new equipment and materials in the existing building.
- B. All new equipment and materials shall be installed in existing building as herein specified.
- C. All Contractors before starting any cutting in the existing building must first obtain approval from the Owner's Representative on the site before cutting at each location. This Contractor shall provide any temporary work required to retain the dust generated by his work as may be directed by the Owner's Representative. All dust found, which has escaped the area of cutting shall be properly removed by the Contractor without additional cost to the Owner.

- D. All openings cut into the exterior of the existing structure must be completely sealed and waterproofed before leaving the job site each day. This shall be done by the Contractor responsible for the cutting.
- E. Contractor should not assume utilities can be installed as shown. Drawings are diagrammatic and utilities may need to shift to accommodate existing conditions. It is believed that in general the project can be constructed with utilities in approximately the locations as shown

1.5 INTERRUPTION OF SERVICES

- A. The Contractor shall schedule his work to avoid any interruption of any utility services to the operating areas of the building during normal working hours. Interruption of services shall be done during off hours at no additional cost to the Owner.
- B. The Contractor shall notify the Owner and the Owner's Representative at least three days prior to any interruption of services. The scheduling of all interruptions shall be approved by the Owner.

1.6 DEMOLITION

- A. Refer to Section 260510 – Electrical Demolition for additional requirements.
- B. The Contractor shall perform all demolition work as indicated on the Drawings as part of this Contract.
- C. The Contractor shall cut and patch as required to perform the demolition work. All openings created must be repaired to match existing conditions.
- D. All cutting and patching shall be performed by mechanics experienced in their respective line of work. If the Owner's Representative is not satisfied with the quality of work, the Contractor shall be required, at his own expense, to engage the General Contractor to replace the damaged materials with new materials.
- E. Contractor shall re-establish circuit continuity to wiring devices that may be affected by the demolition process.
- F. Demolition shall be accomplished in accordance with the construction phasing schedule. Where necessary the Contractor shall provide temporary circuits, supports, equipment, etc. as needed to keep equipment, building area, etc. operational or to allow relocation of the same during demolition of adjacent areas.
- G. Abandoned wire, conduit, devices, and circuits in the area of demolition or individually identified shall be removed in their entirety.
- H. The Owner shall be given the opportunity to retain ownership of all removed materials and equipment. All such items shall be carefully handled and protected and shall be stored by this Contractor on site as directed by the Owner. Any such materials and equipment not desired by the Owner shall become the property of the Contractor and shall be removed promptly from the project site. Disposal shall be in accordance with the regulations of the authorities at the disposal site.
- I. Discovery of any equipment and/or material which is scheduled for removal and which is suspected of containing asbestos shall require termination of demolition until the Owner is informed and proper testing can be conducted to ensure the material does not contain asbestos.

Equipment and/or material found to contain asbestos shall undergo asbestos remediation by others at the cost of the Owner prior to completion of demolition.

- J. Any equipment scheduled for removal found to contain PCB's shall be disposed of in accordance with the Environmental Protection Agency requirements. All disposal documentation shall be delivered to the Owner. Costs of said services shall be the responsibility of the Owner.
- K. Fluorescent lamps shall be recycled and/or legally disposed of in accordance with EPA rules. Contractor shall provide documentation of legal disposal when requested. The cost of disposal shall be the responsibility of the Contractor.

1.7 OWNER FURNISHED EQUIPMENT

- A. The Contractor shall install all equipment designated to be Owner furnished.
- B. The Contractor shall be responsible to receive, store and enforce warranty on the Owner furnished equipment as if it were originally furnished by the Contractor.
- C. The Contractor shall thoroughly inspect the Owner furnished equipment upon receipt. The Contractor shall have 24 hours after receipt to note any damage to the Owner furnished equipment. After that time, the Contractor shall be fully responsible for the condition of the Owner furnished equipment

1.8 HOODS AND SHIELDS

- A. Hoods and shields shall be installed to protect important electrical equipment from sprinkler system discharge. Hoods and shields shall be constructed of non-combustible material and shall be sized to prevent direct contact of the discharging water and the important electrical equipment. The local authority having jurisdiction shall determine what electrical equipment will be classified "important electrical equipment".

1.9 TEMPORARY ELECTRICAL POWER

- A. Refer to Section 260507 – Temporary Power and Communication for additional requirements.
- B. Electrical power from a temporary utility service shall be provided and paid for by the Contractor.
- C. The Contractor must make arrangements with the local utility for power and provide installation of equipment, wiring, switches and outlets necessary to provide adequate supply for lighting and power for construction purposes as well as power for construction site offices and other temporary storage and construction buildings.
- D. The Contractor must provide and maintain lights and signs to prevent damage or injury and must illuminate all hazardous areas. Safety lights must be illuminated during all periods of occupancy.
- E. Materials used for temporary electrical power may be new or used but must be adequate in capacity for the purpose intended and must not create unsafe conditions or violate the requirements of applicable codes
- F. The Contractor shall install all work to have a neat and orderly appearance and to make it structurally sound throughout. The Contractor must maintain all temporary electrical systems to give continuous service and provide safe working conditions.

- G. The Contractor must modify the service as required by the progress of this job.
- H. The Contractor shall remove all temporary equipment and materials upon completion of construction, repair all damage caused by the installation and restore the area to satisfactory construction.

PART 2 - PRODUCTS (Not Used).

PART 3 - EXECUTION (Not Used).

END OF SECTION 260502

SECTION 260503

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS.

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Electrical product general requirements and accesses.
 - 2. Substitutions
 - 3. Submittals.
 - 4. Alternates.
 - 5. Coordination drawings.
 - 6. Record documents.
 - 7. Maintenance manuals.
 - 8. Rough-ins.
 - 9. Electrical installations.
 - 10. Cutting and patching
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. Definitions:
 - 1. Listed: Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintain periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for use in a specified manner.
 - 2. Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
 - 3. General Explanation: A substantial amount of specification language consists of definitions of terms found in other Contract Documents, including Drawings. (Drawings are recognized as being diagrammatic in nature and not completely descriptive of the requirements indicated thereon). Certain terms used in Contract Documents are defined in this article. Definitions and explanations contained in this Section are not necessarily either complete

- or exclusive but are general for the Work to the extent that they are not stated more explicitly in another element of the Contract Documents.
4. General Requirements: The provisions or requirements of other Division 01 Sections apply to entire work of the Contract and where so indicated, to other elements which are included in the project.
 5. Indicated: The term "indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping the reader locate cross- references, and no limitation of location is intended except as specifically noted
 6. Directed, Requested, etc: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "reviewed", "required", "accepted", and "permitted" mean "directed by Architectural/Engineer", and similar phrases. However, no such implied meaning will be interpreted to extend the Architect/Engineer's responsibility into the Contractor's area of construction supervision.
 7. Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations, as applicable in each instance.
 8. Install: Except as otherwise defined in greater detail, the term "install" is used to describe operations at the job site, including unloading, unpacking, assembly, erection, placing, anchoring, mounting, connecting, testing, protecting and cleaning, placing in working condition and similar operations, as applicable in each instance.
 9. Provide: Except as otherwise defined in greater detail, the term "provide" means to furnish and install, complete and ready for intended use, as applicable in each instance.
 10. Installer: The term "installer" is defined as the entity (person or firm) engaged by the contractor, its subcontractor or sub-subcontractor for performance of a particular unit of work at the project site. It is a general requirement that such entities (installers) be expert in the operation they are engaged to perform.
 11. Connect: The term "connect" means to provide power sources, overcurrent devices, raceway, conductors, terminations, insulation and other materials required for the operation and control of the equipment noted by the term
 12. Wiring: The term wiring means all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connectors, splices, and all other items necessary and/or required in connection with such work.
 13. Conduit: The term conduit means the inclusion of all fittings, hangers, supports, sleeves, etc
 14. Concealed: The term concealed means embedded in masonry or other construction, installed behind wall furring or within partitions, or installed within suspended ceilings.
 15. Exposed: The term exposed means not installed underground or concealed as defined above.
 16. Accessible: The term accessible means being capable of being reached without the use of ladders or without climbing or crawling under, through or over obstacles such as other mechanical or electrical equipment, building members or structure, piping, ductwork or going through doors.

1.3 SUBMITTALS.

- A. General: Follow the procedures specified in Division 01 Section "Submittal Procedures" and Section 260501 "Basic Electrical Requirements."
1. If submittals include any deviations from specified equipment/materials, these deviations must be clearly identified. The reason for the deviation must also be indicated. Exceptions must be included in/on the submittal in a separate paragraph or drawing block located

- below the Contractor's stamp identified by the title "Exception to Contract Documents." Exceptions cannot be part of the standard Contractor's stamp.
2. Transmit each submittal with an Engineer accepted form. Include one copy each for the Owner and the Owner's Representative in addition to copies required by the Contractor.
 3. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.
 4. Identify Project, Contractor, Sub-Contractor or Supplier; pertinent drawing sheet and detail number and specification section number, as appropriate.
 5. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- B. Incomplete submittals shall not relieve the Contractor of providing a complete and functional system.
- C. Schedule submittals to expedite the Project. Coordinate submission of related items.
- D. Submittals by the Contractor must be in complete compliance with the Contract Documents unless exceptions are identified. Exceptions to the Contract Documents may only be made to improve the project. Exceptions cannot be taken which would provide an incomplete and/or nonfunctional system.
- E. Prepare shop drawings and obtain approvals from inspection authorities for power utility company, fire alarm and life systems, and other electrical installations requiring specific approval.
- F. Prepare and submit all shop drawings to governmental agencies and utility companies which are required by these agencies for their approval.
- G. Submit coordination drawings for areas specified and those areas defined as "problem" coordination areas during construction.
- H. Provide space for Contractor and Owner's Representative review stamps.
- I. The Engineer will return shop drawings with the following designations:
1. Approved: Further submission not required.
 2. Approved as Noted: Corrections must be incorporated in final installation. Further submission not required unless specifically noted.
 3. Not Reviewed: Placed in project files for information only.
 4. Revise and Resubmit: Make necessary changes and resubmit prior to fabrication or purchase.
 5. Not Approved: Does not meet project requirements. Resubmit in accordance with Contract Documents.
- J. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- K. Submit ¼" scaled coordination drawings in electronic PDF format of electrical equipment room layouts prior to issuing electrical equipment submittals to engineer of record. Layout shall be based on equipment being submitted for approval. In addition to electrical equipment room layouts, contractor shall also include all major conduit raceway systems 2" conduit trade size and larger for both underground and overhead including all pull and junction boxes. The contractor's electrical coordination drawings shall be fully coordinated with all trade contractor's equipment and shall bear each trade contractor's approval stamp and signature on each coordination plan drawing submittal.

- L. Electronic drawing files in AutoCad of the electrical drawings for use in preparing submittals may be purchased from the engineer. These drawings will not be provided without charge to the contractor or any of the subcontractors.
- M. Documents will not be accepted for review unless:
 - 1. They comply as to number of copies and type of paper indicated in the General Requirements.
 - 2. They include complete information pertaining to appurtenances and accessories.
 - 3. They are submitted as a package where they pertain to related items.
 - 4. Where they consist of standard catalog sheets displaying other items which are not applicable, they are properly marked with the electrical data, product identification and accessories as related to this specific project.
 - 5. They indicate the project and address along with the Contractor's name, address and phone number.
 - 6. Where they consist of standard factory assembly or field installation drawings, they are properly marked with external connection identification as related to this specific project.
- N. Any materials, fixtures, apparatus, or equipment that are not in accordance with specification requirements can and will be rejected for use in this installation and construction
- O. Any materials, fixtures, apparatus or equipment installed without stamped or written review will be removed by the Contractor and replaced with specified equipment at the direction of the Architect/Engineer and without recourse for additional compensation.
- P. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.4 SHOP DRAWING/PRODUCT DATA

- A. Submit shop drawings and/or catalog cuts for all specified materials and equipment.
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.
- D. Show equipment sizes and dimensions.
- E. Include wiring diagrams, hole location and sizes, and other data that could affect work by other trades.
- F. Show manufacturer's names, trade names, catalog numbers, accessories, special features and rating data.
- G. Indicate required clearances for operating parts, for removal and for servicing
- H. Show all applicable performance data.
- I. Show sound power levels of all rotating equipment.

1.5 QUALITY ASSURANCE

- A. Carefully examine the contract documents, visit the site, and become thoroughly familiar with the local conditions relating to the work. Failure to do so will not relieve the contractor of the obligations of the Contract.
- B. Discovery of any conflicting design information or any design intentions which are not readily interpreted shall be referred to the Architect/Engineers for further description or illustration prior to any product selection or execution of work.
- C. Discovery of any materials or equipment which are damaged, unsuitable, incompatible, or non-compliant with any applicable codes, laws, ordinances or other regulations shall be brought to the direct attention of the Architect/Engineer.
- D. Should there be any discrepancies or question of intent, refer the matter to the Architect/Engineer for a final decision before ordering any equipment or materials and before starting any relating work.
 - 1. In case of conflict between project specifications and drawings, the Contractor shall assume the more expensive method for purposes of bidding, unless the Architect/Engineer rules otherwise.
- E. Manufacturers of equipment shall be firms regularly engaged in manufacturing factory fabricated systems and equipment whose products have been in satisfactory use in similar service for not less than 5 years.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery product to the project properly identified with names, model numbers, types grades, compliance labels, and other information needed for identification.

1.7 RULES AND REGULATIONS

- A. Work and materials shall conform to and be execute, inspected and tested in accordance with the latest edition of the governing rules and regulations of Federal, State and Local governmental agencies.
- B. Other codes which will apply to this installation include the current editions of:
 - 1. ANSI C2 – National Electrical Safety Code.
 - 2. ASME/ANSI A17.1 - Safety Code for Elevators and Escalators.
 - 3. ASTM - American Society for Testing and Materials.
 - 4. ICEA - Standards for Wire and Cable.
 - 5. IEEE Standards.
 - 6. IESNA Standards.
 - 7. NEMA Standards.
 - 8. NFPA 20 - Standards.
 - 9. OSHA Regulations.
 - 10. Underwriters Laboratories.
- C. Where governing codes indicate the Drawings and Specifications do not comply with the minimum requirements of applicable codes, the Contractor shall either notify the Architect/Engineer in

writing during the bidding period identifying the revisions required to meet code requirements or provide an installation which will comply with the code requirements.

- D. Where regulations of electric utility and telephone companies apply, conformance with their regulations is mandatory and any costs involved shall be included in the Contract, with the exception of extra facility and other charges which are directly paid by the Owner.
- E. Where any materials, equipment or installation is not in compliance with the more stringent of the applicable codes, laws, ordinances, regulations and contract documents, they shall be entirely removed, replaced, modified or otherwise corrected at no additional cost to the Owner.

1.8 SUBSTITUTION

- A. The materials, products and equipment described in the Bidding Documents establish a standard of required functions, dimensions, appearance and quality to be met by any proposed substitutions.
- B. No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect/Engineer at least ten (10) days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance, test data and warranties, and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or other work than incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Architect approved any proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. This Addendum shall then be issued to all Bidders.
- D. Requests for substitution shall be made only by a Bidder. Request for substitution received by the Architect from Sales representative, vendors, suppliers etc., are not acceptable.
- E. Any bidder wishing to substitute "or equal" equipment may request a substitution. Manufacturer's which are submitted as substitutions for approved equal status are considered to have equipment of similar quality, however, the Contractor shall not assume that a piece of equipment by a manufacturer submitted as a "substitution" will be automatically accepted. Compliance with the Drawings and Specifications is still required. If the substituted material is considered to be unacceptable, the Contractor shall provide the equipment as originally specified.
- F. Substitutions are encouraged when there is significant cost savings or improvement to the project. Submit reasons for changes with any requests for substitution. All requests for substitutions must be made within 30 days of contract award unless stated otherwise in the General Conditions.
- G. Bid alternates shall be clearly defined in order to be evaluated during the bidding process.
- H. By submitting an alternate or substitution, the Contractor automatically agrees to the following.
 - 1. The Owner/Architect/Engineer shall be reimbursed by the Contractor for any additional costs incurred by the Owner's Representative to review the substituted materials, in accordance with the then current Owner's Representative's hourly rate.
 - 2. The Owner shall be reimbursed by the Contractor for any additional costs incurred by the Owner's Representative field or office conferences caused by the substituted materials in accordance with the then current Owner's Representative's hourly rate.

3. The consideration of alternates/substitutions does not obligate the Owner's Representative to accept same
- I. In the event a brand is approved and substituted, it is the responsibility of the Contractor to so coordinate his substituted material into the original work at no extra cost to the Owner or any other Contractor.
- J. Refer to Division 01 Section "Substitution Procedures" for additional instructions on substitution.

1.9 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Openings: Wall, floor, ceiling, and roof openings specifically shown and identified on the Architectural and Structural or Electrical Drawing shall be provided.
- B. Roof Sleeves: Electrical Contractor shall provide all roof penetrations and sleeves for all conduits serving HVAC equipment and shall be incorporated into the finished roofing and made watertight according to the roof construction type manufacturer's recommendations.
- C. Painting: Painting of all exposed-to-view conduit, pipes, unfinished hangers, supports, and equipment, insulated or not, in finished and unfinished areas, shall be provided. Furnish all manufactured equipment in factory-finished baked enamel, unless otherwise specified.

1.10 WIRING AND CONTROLS

- A. Wiring and controls associated with equipment shall be furnished, installed, and wired in accordance with the manufacturer's recommendations and applicable standards and codes. Provide installation instructions, locating dimensions, and wiring diagrams for the other trades. Supervise the installation and start-up and test the equipment unless otherwise specified.
- B. Equipment Furnished by Other Divisions: Equipment specified in other Divisions and requiring electrical supply shall be erected, aligned, leveled, and prepared for operation. Provided required controls and accessories along with installation instructions, diagrams, dimensions and supervision of installation and start-up. Provide the required electrical rough-ins, and confirm the electrical controls and accessories furnished under the specifications for the other Divisions. Install those controls and accessories not located in the mechanical piping and ductwork. Provide additional electrical controls, accessories, fittings, and devices not specified under the equipment but required for a finished, operating job. Make final electrical connections. Participate in the start-up and test services.

1.11 PERMIT AND INSPECTIONS

- A. Permits: Obtain and pay for all permits, bonds, licenses, tap-in fees, etc., required by the City, State, or other authority having jurisdiction over the work, as a part of the work of the affected Section.
- B. Inspections: Arrange and pay for all inspections required by the above when they become due as part of the work of the Sections affected. Conceal no work until approved by these governing authorities. Present the Contractor, Architect/Engineer with properly signed certificate of final inspection.

1.12 REVIEW OF MATERIALS

- A. Within 21 calendar days after award of this Contract, submit a typewritten list of all items of equipment and material proposed for installation on this Project to the Architect/Engineer for review for design conformance. Set forth the specification page number, manufacturer's name, model number, size, nonstandard accessories specified or required, and any other information required to identify each item.

1.13 PROJECT SITE CONDITIONS

- A. Inspect and examine the site before submitting the proposal. Note the location of any existing facilities, existing services or interference with other trades. Immediately contact Architect/Engineer indicating discrepancies. Failure to do so will not relieve the Contractor of the obligations of the Contract.
- B. Visit the site or premises in order to become familiar with job conditions. No extras will be allowed for work which could have been foreseen by an examination of the site or premises.
- C. Adjust work to meet actual conditions existing at the job.
- D. Inspect and examine the site to determine how equipment will be transported to final mounting locations. No extra charges will be allowed for moving, hoisting or otherwise transporting equipment to final mounting location.
- E. The location and routing of power and communication utility service raceway systems shown on the site plan and associated plan drawings are diagrammatic only. The contractor shall coordinate with all new and existing overhead and underground utilities (power utility service company, communication utility service company, etc.). Contractor shall verify and confirm with power and communication service utility providers the exact location and routing of proposed underground and overhead conduits prior to rough-in. Contractor shall obtain an official sign-off from such utility service providers prior to performing any work. Failure to do so shall not relieve the contractor from providing what is required by the utility service providers and shall not result in an added cost to the contract.

PART 2 - PRODUCTS.

2.1 MATERIALS.

- A. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Seconds, rejects, or damaged materials will be rejected.
- B. The equipment to be provided under these Specifications shall be essentially the standard commercial grade product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer.
- C. The listing of a manufacturer for certain equipment and systems does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems shall conform to the Specifications.

2.2 U.L. LISTING & LABELING

- A. All equipment shall bear the Underwriter's Laboratories (U.L.), or other approved agency, listing label.
- B. Isolation Rail Construction.

PART 3 - EXECUTION.

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 02 through 14, 22, 23, and 26 for rough-in requirements.

3.2 ELECTRICAL INSTALLATION.

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 - 1. The Architect shall control the placement of wall and ceiling mounted electrical devices, fixtures, and outlets. The intent is to aesthetically locate fixtures/outlets by providing rough-in hardware, boxes and/or mounting plates, as required, when stud or furring may not be readily available for direct mounting. When drawing details are not available, consult with Architect's representative for actual placement.
 - 2. Coordinate electrical systems, equipment, and materials installation with other building components. Be responsible for any changes in openings and locations necessitated by the equipment installed.
 - 3. Verify all dimensions by field measurements.
 - 4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 - 5. Coordinate the installation of required supporting devices and sleeves to be set in poured-in- concrete and other structural components, as they are constructed
 - 6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building
 - 7. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 - 9. Switchgear/Switchboard/Motor Control Center Assembly Selection: The drawings indicate sizes, profiles, and dimensional requirements of assembly equipment. Equipment having equal performance characteristics and complying with indicated maximum dimensions and profiles may be considered, provided deviations do not change the design concept, intended performance, or code/future extension provision clearances. The burden of proof of equality is on the proposer a minimum of 10 days prior to bid.

10. Protect all equipment and materials from the elements, dirt and other damage from the time it is removed from the point of storage until final acceptance.
11. Equipment shall include the component parts thereof such as disconnect switches, motor starters, motors, drives, and guards necessary to the satisfactory and safe operation of the equipment.
12. Installation shall include setting equipment to accurate line and grade, leveling equipment, aligning equipment components, providing and installing couplings, bolts, guards and anchor bolts.
13. All tolerances in alignment and leveling, and the quality of workmanship for each class and stage of work shall be subject to manufacturer's installation instructions.
14. All manufacturers' finished equipment surfaces damaged during construction shall be brought to an "as new" condition by touch up or repairing. Any rust shall be completely removed and the surface primed prior to repainting.
15. Workmanship shall conform to the "Standard of Installation" published by the National Electrical Contractors Association.
16. Prior to start of utility trench work, notify the Architect of utilities that require excavations lower than the building foundations. Do not proceed with trench work without direction from the Architect to ensure the building foundations will not be compromised by the utility installation.
17. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from the premises when no longer required.
18. No electrical equipment, raceways or other work of any kind shall be covered up or hidden from view before it has been examined and approved. Any unsatisfactory work or materials shall be removed and corrected immediately.
19. Install systems, materials, and equipment level and plumbing, parallel and perpendicular to other building systems and components.
20. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
21. Install access panels or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 26 Section "Basic Electrical Materials and Methods".
22. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 MANUFACTURER'S DIRECTIONS AND SUPERVISION.

- A. Where supervision by a manufacturer is specified, follow all instructions, recommended manufacturer and specified field tests, and other recommendations of the manufacturer. The manufacturer shall supervise the installation, connection, start-up, testing, and adjustment, instruction of the Owner and final tests of such equipment or system. Where two or more manufacturer's equipment are interrelated, take responsibility to coordinate their work and provide supervision.
- B. Have the manufacturer instruct the Owner in the proper operation and maintenance techniques of all equipment, systems, etc., at the time of completion of all work.
- C. Prior to final acceptance by the Owner prepare and submit to the Architect for review 3 copies of operation and maintenance (O and M) instructions in printed form for each item of equipment or system installed in the building. Complete instructions for each system shall be assembled and bound in a brochure. Detailed contents of the O and M manuals are as hereinafter specified. Refer to appropriate Division 01 Sections for general requirements affecting this work.

3.4 PAINTING.

- A. Provide the prime painting of all equipment and materials furnished under Division 26 specifications, unless specifically stated otherwise. In general, all equipment except raceways and galvanized boxes that are not provided with a factory-applied final finish shall be delivered to the job site with a shop-applied prime coat of paint:

3.5 TEST AND INSPECTION.

- A. Upon completion of the work, notify the Architect in writing, that the entire electrical installation has been examined, inspected, tested, calibrated or adjusted as specified and that it is ready for final inspection. Work to be connected prior to final inspection and also to include all of the work specified for "Manufacturers' Directions and Supervision.". Include documentation of specified testing and inspection
- B. Prior to each inspection, provide a written certification that each system or piece of equipment to be operated during that test has been tested and does meet design performance criteria of the Contract Documents.
- C. On completion of work, obtain Certificates of Compliance, and approval or acceptance from all authorities having jurisdiction over the work, and deliver these certificates to the Architect. The work shall not be deemed to have reached a state of completion until the certificates have been delivered.

3.6 LOOSE EQUIPMENT.

- A. Provide four keys for every different piece of electrical equipment which is equipped with a lock.
- B. Provide all other loose equipment specified/supplied for use with all systems.

3.7 SHOP DRAWINGS

- A. Refer to Division 01 for quantities and types of shop drawings.
- B. Required shop drawings shall be submitted in groups by systems. For example, all lighting fixtures, lamps, ballasts and accessories shall be submitted simultaneously in one package.
- C. Refer to individual Division 26 Sections for required shop drawings.
- D. Shop drawings submitted for other than those specifically required in the appropriate Specification Section will not be reviewed or returned

3.8 OPERATION AND MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 01 Section "Operating and Maintenance Data". In addition to the requirements specified in Division 01, include specific Division 26 Section requirements, and the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
- B. Prior to completion of this project, the Contractor shall deliver to the Owner's Representative for approval three copies of an Operating and Maintenance Manual consisting of items outlined hereinafter.
- C. The purpose of this manual is to assist the Owner in routine operation, maintenance, servicing, troubleshooting and procurement of replacement parts. All information in the manual shall be as-built and only material pertinent to the project shall be included.
- D. The manual shall include the following:
1. Manuals shall be bound, 8-1/2 x 11 inch text pages and set in three-ring binders with durable covers.
- E. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of project and subject matter of binder when multiple binders are required. All subject matter shall be in typewritten format.
- F. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab labeling clearly printed under reinforced laminated plastic tabs.
1. Contents: Prepare a Table of Contents for each volume with product or system description identified, type on white paper
 2. Part 1: Directory, listing names, addresses and telephone numbers of Owner's Representative, Contractor, Sub-Contractors and major equipment suppliers.
 3. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses and telephone numbers of Sub-Contractors and suppliers. Operating and start-up instructions shall be written in a concise step-by-step manner. Maintenance instructions shall include maintenance schedules, procedures, adjustments and trouble-shooting techniques. Identify the following:
 - a. List of equipment.
 - b. Parts list for each component.
 - c. Operating instructions.
 - d. Maintenance instructions for equipment and systems.
 4. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Control wiring diagrams.
 - c. Certificates.
 - d. Photocopies of warranties.
 - e. Electrical inspection certificate.
 - f. Copy directory and Schedule of loads served for each:
 - 1) Branch circuit panel.
 - 2) Distribution panel.

- g. Individual Characteristics for trouble shooting sequences for each item of:
 - 1) Branch circuit panel.
 - 2) Distribution panel.
 - 3) Fire alarm system.
 - 4) Individual motor starter.
 - 5) Generator and associated transfer switch(es).
 - h. On-hand spare parts list and complete parts list for each:
 - 1) Distribution panel.
 - 2) Individual motor starter.
 - i. Bolt tightening torques and inspection intervals on each:
 - 1) Bolted bus connection.
 - 2) Cable connection.
 - 3) Miscellaneous bolted electrical connections.
 - j. Manufacturers' recommended cleaning intervals and special procedures for each:
 - 1) Cooling fins.
 - 2) Electrical equipment interior.
 - 3) Electrical equipment ventilation opening.
 - 4) Lighting fixture lenses, louvers and reflectors.
 - k. Main and arcing contact adjustment and replacement for each.
 - 1) Contractor.
 - 2) Circuit breaker.
 - 3) Fused switch.
 - 4) Interrupter switch.
 - 5) Motor starter.
 - l. Calibration and exercise procedures and intervals for each:
 - 1) Control system.
 - 2) Emergency battery.
 - 3) Molded case-breaker.
 - 4) Relay.
 - m. "As designed" and "as left" relay settings.
 - n. Testing interval and target values for ground fault protection circuit relays.
 - o. Testing and trouble shooting procedures unique to special systems.
 - p. Approved special construction details that differ from the details shown on Drawings.
 - q. Commissioning reports for systems per 26 08 00 COMMISSIONING FOR ELECTRICAL
5. Submit one copy of completed volumes in final form 30 days prior to final inspection. This copy will be returned after final inspection, with the Owner's Representative comments. Revise content of documents as required prior to final submittal.
6. Submit final volumes revised, within ten days after the Owner's review.

3.9 COORDINATION DRAWINGS

- A. In addition to the required manufacturer and "field" Shop Drawing submittals, all trades shall participate in the preparation of composite coordination drawings.
- B. Each trade shall show planned mechanical/plumbing work and participate in a minimum of 15 coordination meetings initiated by the General Contractor. Meetings shall include installers of plumbing, HVAC, fire protection, insulation, and electrical work
- C. Under the General Contractor's supervision, the ductwork contractor shall prepare composite utility/service drawings which overlay all trades' work

- D. The completed drawings shall show interfaces of ductwork, electrical conduit and cable trays, fire protection and plumbing lines sized 1-1/2 inch and above (diameters include exterior insulation). All drain lines shall be illustrated regardless of size to insure adequate "fall" is achievable in concealed cavities.
- E. Prepare drawings to show clearances for installing and maintaining insulation, breaking down equipment, pulling tubes, replacing filters and motors, valve stem movement and similar requirements.
- F. Provide details and sections as needed to conclusively show successful coordination and integration of work.
- G. Access door requirements to satisfy the needs of Paragraph E shall be located.
- H. Professional will not supervise coordination which is the exclusive responsibility of the Contractor.
- I. Prepare coordination drawings to a scale of $\frac{1}{4}" = 1'-0"$ or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited to installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
 - 1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
 - a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Exterior wall and foundation penetrations
 - c. Fire-rated wall and floor penetrations.
 - d. Equipment connections and support details.
 - e. Sizes and location of required concrete pads and bases.
 - 2. Coordination drawings shall be provided by Division 26 for the following:
 - a. Access door locations.
 - b. Communication rooms.
 - c. Electrical equipment rooms.
 - d. Mechanical equipment rooms.
 - 3. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - 4. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

3.10 RECORD "AS-BUILT" DOCUMENTS

- A. The Contractor shall be responsible for creating and providing accurate "As Built" drawings from field data collected during the course of the project. Field data is defined as information collected on site while constructing the project that is not available from the contract documents, addenda, change orders, or site instructions. It is of importance that the Contractor record on the "As Builts" all field information relating to concealed conditions.

- B. During construction, the Contractor shall maintain a record set of "red-lined" installation prints. He shall record on these prints, all deviations from the Contract Drawings in conduit and electrical conductor sizing, equipment sizing, location and details.
- C. The revisions from contractor markups and field inspection notes shall be transferred to the final as-built set of drawings. The final as-built drawings include modifications during construction, field requested changes, bulletins, shop drawing modifications, and contractor designs.
- D. At the completion of construction, all of the contractor's red-lined changes shall be transferred to PDF electronic drawings format, typically using the engineer of record's original design drawing files as the starting point. These PDF drawings shall then be considered the final "as-builts" and shall be submitted to the engineer and owner in PDF format as part of the project close out process. Hand marked-up as built drawings shall not be acceptable.
- E. Prepare record "As-Built" documents/drawings in accordance with the requirements in Division 01 Section "Project Closeout." In addition to the requirements specified in Division 01, indicate installed conditions for:
 - 1. Plan drawings indicating major raceway systems (100 amps and greater), conduit and wire sizes, routing and location, for both exterior and interior, locations of equipment, switchboards, panelboards, control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 - 2. Major equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 3. Accurate electrical diagrams (electrical riser diagrams, wiring diagrams, etc.) reflective of all modifications during construction, field requested changes, bulletins, shop drawing modifications, and contractor designs.
 - 4. Accurate record of all switchboard and panelboard branch circuit directories/schedules which reflect actual installed circuits.
 - 5. Accurate branch circuit numbers and associated panelboard designations of all power receptacle outlet devices, electrical equipment, lighting fixtures and associated controls, etc.
 - 6. Contract Modifications and actual equipment and materials installed.
- F. Engage the services of a Professional Engineer registered in the State of Maryland to record the locations and invert elevations of underground raceway installations.

END OF SECTION 260503

SECTION 260505

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes the limited scope construction materials and methods for application with electrical installations as follows:
 - 1. Excavation for underground utilities and services, including underground raceways, vaults, and equipment.
 - 2. Miscellaneous materials for support of electrical materials and equipment
 - 3. Concrete equipment bases.
 - 4. Cutting and patching for electrical construction.
 - 5. Touchup painting
 - 6. Mounting heights.
 - 7. Electrical equipment coordination and installation.
 - 8. Sleeves for raceways and cables.
 - 9. Sleeve seals.
 - 10. Common electrical installation requirements.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 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. Sub-base: As used in this Section refers to the compacted soil layer used in pavement systems between 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.

1.3 SUBMITTALS.

- A. Shop drawings are not required for material and equipment specified under this Section of the specifications.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- B. Comply with local authorities having jurisdiction.
- C. Installer Qualifications: Engage an experienced installer for the installation and application of joint sealers, access panels, and doors.
- D. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code-Steel".
 - 1. Certify that welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

- A. 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. If utilities are indicated to remain, support and protect services during excavation operations.
 - 5. Remove existing underground utilities indicated to be removed.
 - a. Uncharted or Incorrectly Charted Utilities, contact utility owner immediately for instructions.
 - b. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to Architect prior to utility interruption.
 - 6. Use of explosives is not permitted.
- B. 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.

1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow:
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
 - 1. Coordinate installation and connection to exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services
- C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 08 Section "Access Doors and Frames".

PART 2 - PRODUCTS.

2.1 PRODUCTS.

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers.
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metrafex Co.
 - 4. Pipeline Seal and Insulator, Inc.

2.2 MISCELLANEOUS MATERIALS

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- D. Expansion Anchors: Carbon-steel wedge or sleeve type.
- E. Toggle Bolts: All-steel springhead type.
- F. Powder-Driven Threaded Studs: Heat-treated steel.

2.3 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 03 Section "Cast-in-Place Concrete".
- B. Concrete: 3000 psi, 28 day compressive strength as specified in Division 03 Section "Cast-in-Place Concrete".

2.4 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.5 SLEEVES FOR RACEWAYS

- 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 with minimum 0.052 inch or 0.138 inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

2.6 SLEEVE

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of conduit. Include type and number required for material and size of raceway.
 - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

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 access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 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 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 Vaults and Electrical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; 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 dri-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 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 place.
- G. Trenching: Excavate trenches for electrical 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 clearance on both sides of raceways and equipment.
 2. Excavate trenches to depth indicated or required.
 3. Limit the length of open trench to that in which installations can be made 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 raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations
- H. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F.
- 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 walls 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 raceways less than 30 inches below surface of roadways, provide 4 inch thick concrete base slab support. After installation of raceways, provide a 4 inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
 5. 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 in loose depth for material compacted by heavy equipment, and not more than 4 inches 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 raceways and equipment by carrying material uniformly around them to approximately 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: Company 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).
 - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches 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.
 - b. Areas Under Walkways: Compact top 6 inches 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.
 - c. Other Areas: Compact top 6 inches 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.
 2. 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 electrical installation excavations during the period 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 of finish to match adjacent areas.

3.3 ELECTRICAL EQUIPMENT INSTALLATION.

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.4 FIRESTOPPING.

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor, ceiling and wall assemblies to achieve fire-resistance rating of the assembly. Provide 3M™ Fire Barrier Moldable Putty Pads. MPP+ shall be a one component, ready-to-use, intumescent elastomer capable of expanding a minimum of 3 times at 1000°F. The material shall be thixotropic and shall be applicable to overhead, vertical and horizontal firestops. Under normal conditions, 3M™ Fire Barrier Moldable Putty Pads MPP+ shall be noncorrosive to metal and compatible with synthetic cable jackets. The putty shall be listed by independent test agencies such as UL, Intertek or FM. 3M™ Fire Barrier Moldable Putty Pads MPP+ shall be tested to and pass the criteria of ASTM E 814 (UL 1479) Standard Test Method for Fire Tests of Penetration Firestop Systems and CAN/ULC S115 Standard Method of Fire Tests of Firestop Systems. 3M™ Fire Barrier Moldable Putty Pads MPP+ meets the requirements of the IBC, NFPA 5000, NEC (NFPA 70), NFPA 101.
- B. Additional firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping".
- C. Provide Endothermic Mat where electrical boxes, panels and equipment are installed within fire rated floors, walls and ceilings using 3M™ Instream™ Endothermic Mat products to match fire ratings.

3.5 CONCRETE BASES.

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000 psi, 28 day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways penetrate concrete slabs, concrete or masonry walls, or fire- rated floor and wall assemblies.

- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- C. 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.
- D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- E. Rectangular sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to or greater than 50 inches, and 1 or more sides equal to or greater than 16 inches, thickness shall be 0.138 inch
- F. 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.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches above finished floor level.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway penetration sleeves with firestop materials. Comply with Division 07 Section "Penetration Firestopping".
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.7 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 01 Section "Cutting and Patching." In addition to the requirements specified in Division 01, the following requirements apply:
 - 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover Work to provide for installation of ill-timed Work.

- b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents
 - d. Remove samples of installed Work as specified for testing.
 - e. Upon written instructions for the Architect, uncover and restore Work to provide for Architect observation of concealed work.
2. Cut, remove, and legally dispose of electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and direct to adjacent areas.
5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
6. Patch finished surfaces and building components using new materials matching materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.8 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 1. Excavation for underground utilities.
 2. Concrete bases.
 3. Cutting and patching for electrical construction.
 4. Touchup painting.
- B. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

3.9 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 09 Section "Painting".
 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer

3.10 MOUNTING HEIGHTS

- A. Mounting heights of electrical items shall be as listed below, unless otherwise specified, or by the Architect/Engineer's field instructions. Dimensions are above finished floor, unless otherwise indicated. In areas where code requires different mount heights, as in hazardous areas, comply with code requirements.

1. General Receptacles-18" to C.L.
2. Outdoor Receptacles-24" to C.L.
3. General Tele and Data Outlets-18" to C.L.
4. General Toggle Switches-46" to C.L.
5. Fire Alarm Pull Stations-46" to C.L.
6. Security Call Stations-48" to C.L.
7. General Television Outlets-18" to C.L.
8. Fire Alarm Audio Visual Devices-80" to C.L.
9. General Wall Mounted Lights-90" to C.L.
10. Corridor Wall Sconces (>4" deep)-66" to C.L.
11. Exit Signs-90" to C.L.
12. Individual Disconnects and Starters-60" to C.L.
13. Grouped Disconnects and Starters>12" to C.L.>72" to C.L.
14. Panelboard Overcurrent Devices>12" to C.L.>72" to C.L.
15. Grouped Utility Revenue Meters: >30" to C.L.>66" to C.L.

3.11 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 260505

SECTION 260507

TEMPORARY POWER AND COMMUNICATION SYSTEMS.

PART 1 - GENERAL

1.1 SUMMARY.

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
 - 3. Section 230502 "Special Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 SUBMITTALS.

- A. Site Plan: Show temporary construction trailer and/or building facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Electrical contractor shall complete and submit a temporary electrical service meter application (load letter) to the local power utility company indicating requested electrical service size, voltage, and all associated loads. Load letter shall also include service start and completion dates.

1.3 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, Local Building Code and Local Power utility service requirements.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

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

PART 2 - (Not Used).

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. Temporary overhead/underground electric power utility service shall be coordinated with local power utility company. Provide all electrical equipment infrastructure, connections and extensions of utility services and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Pay electric power service use charges for electricity used by all entities for construction operations.
 - 1. Provide a temporary commercial AC electrical service rated not less than 400 amps at 120/208v, 3-phase, 4-wire, 60 Hz. For construction equipment and a separate temporary commercial AC electrical service rated not less than 100 amps at 120/208V, 3-phase, 4-wire, 60 Hz. For construction trailer(s).
 - 2. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 - 3. Install electric power service overhead, unless otherwise indicated.
 - 4. Connect temporary service to Owner's existing power source, as directed by Owner.
- B. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, security, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.
- C. Telephone Service: Provide temporary telephone service in common-use facilities and/or contractor's construction trailer for use by all construction personnel. Install three T1 telephone line(s) for each field office, whether it is in the contractor's construction trailer or on-site building construction facility.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
 - b. Provide one telephone line(s) for Owner's use.
 - 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.

- d. Architect's office.
 - e. Engineers' office.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
- 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- D. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, video surveillance security systems in common-use facilities and site.
 - 1. Provide one high speed DSL or T-1 line in primary field office.
 - 2. Coordinate with telephone utility company a minimum of four (4) weeks prior to construction start date.

END OF SECTION 260507

SECTION 260510
ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of existing electrical equipment, wiring, and conduit throughout the entire facility as indicated on drawings; removal of designated construction; dismantling, cutting and alterations for completion of the work.
2. Disposal of materials.
3. Storage of removed materials.
4. Identification of utilities.
5. Salvaged items.
6. Protection of items to remain as indicated on Drawing.
7. Relocate existing equipment to accommodate construction.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
3. Section 230502 "Special Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 CLOSEOUT SUBMITTALS

- A. Project Record Documents:** Record actual locations of capped utilities.

1.3 SCHEDULING

- A. Schedule work to coincide with new construction.**
- B. Cease operations immediately when structure appears to be in danger and notify the Owner. Do not resume operations until directed.**

1.4 COORDINATION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.**
- B. Shut down periods:**
1. Arrange timing of shut-down periods of in-service panels with the Owner. Do not shut down any utility without prior written approval.

2. Keep shut-down period to minimum or use intermittent period as directed by the Owner.
3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 days in advance.

PART 2 - PRODUCTS (Not Used).

PART 3 - EXECUTION.

3.1 EXAMINATION.

- A. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- B. Verify termination points for demolished services.

3.2 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Contractor's employees, and existing improvements to remain.

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to the Owner or his representative before disturbing existing installation.
- B. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- C. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- D. Install temporary wiring and connections to maintain existing systems in service during construction.
- E. Do not perform work on energized electrical equipment or circuits.
- F. Remove, relocate, and extend existing installations to accommodate new construction.
- G. Repair adjacent construction and finishes damaged during demolition and extension work.
- H. Clean and repair existing equipment to remain or to be reinstalled.
- I. Protect and retain power to existing active equipment remaining.
- J. Cap abandoned empty conduit at both ends.

3.4 SALVAGE ITEMS.

- A. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.5 CLEANING

- A. Remove demolished materials as work progresses. Legally dispose.
- B. Keep workplace neat.

END OF SECTION 260510

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Nonmetallic underground conduit with conductors, Type NUCC.
3. Metal-clad cable, Type MC.
4. Armored cable, Type AC.
5. Fire-alarm wire and cable.
6. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For each conductor and cable indicating lead content

C. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. All building wiring shall be of copper material. Aluminum shall not be permitted to be used.**

2.2 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. American Bare Conductor.
 - 3. Belden Inc.
 - 4. General Cable Technologies Corporation.
 - 5. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type NM: Comply with UL 83 and UL 719.
 - 2. Type USE-2 and Type SE: Comply with UL 854.
 - 3. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 4. Type THHN and Type THWN-2: Comply with UL 83.
 - 5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 6. Type UF: Comply with UL 83 and UL 493.
 - 7. Type XHHW-2: Comply with UL 44.

2.3 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. Belden Inc.
 - 3. General Cable Technologies Corporation.
 - 4. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:

1. Single circuit and multicircuit with color-coded conductors.
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
1. Type TFN/THHN/THWN-2: Comply with UL 83.
 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Steel, interlocked.
- I. Jacket: PVC applied over armor.
- 2.4 ARMORED CABLE, TYPE AC
- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alpha Wire Company.
 2. Belden Inc.
 3. General Cable Technologies Corporation.
 4. Southwire Company.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Comply with UL 4.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
1. Single circuit and multicircuit with color-coded conductors.
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Bare Insulated.
- G. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.
- H. Armor: Steel, interlocked.

2.5 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. Belden Inc.
 - 3. General Cable Technologies Corporation.
 - 4. Southwire Company.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG or size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

2.6 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Electrical Products.
 - 2. AFC Cable Systems; a part of Atkore International.
 - 3. Hubbell Power Systems, Inc.
 - 4. Ideal Industries, Inc.
 - 5. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 6. Service Wire Co.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 - 2. Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 - 1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 - 2. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. ASD Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway, Armored cable.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
 - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
 - 4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.
- D. Comply with requirements in Section 283111 " Digital, Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors feeding the following critical equipment and services for compliance with requirements:
 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
 2. Results that comply with requirements.
 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.
- C. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
 - 1. Product Data: For each conductor and cable indicating lead content.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.

- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Ground rods.
 - 3) Ground rings.
 - 4) Grounding arrangements and connections for separately derived systems.
 - b. Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Products Division.
 - 2. Burndy; Hubbell Incorporated, Construction and Energy.
 - 3. Harger Lightning & Grounding.
 - 4. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.
- D. Lead Content: Less than 300 parts per million.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

- M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- N. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- O. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
- P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- Q. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector.
- R. Lead Content: Less than 300 parts per million.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.
- C. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 1/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- F. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.
- B. Transformer: Install grounding electrode(s) at the transformer location to building steel and the building grounding electrode system. The electrode shall be connected to the equipment grounding conductor and to the frame of the transformer.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-

copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building's foundation.
- J. Concrete-Encased Grounding Electrode: Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Concrete-Encased Grounding Electrode: Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.
- L. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

- B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

- C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.

2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) 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.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event"
 2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame Rating: Class 1.
 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Allied Tube & Conduit; Atkore International.
 - c. B-line; Eaton, Electrical Sector.
 - d. Flex-Strut Inc.
 - e. G-Strut.
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 4. Channel Width: Selected for applicable load criteria.
 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) MKT Fastening, LLC.
 - 3) Simpson Strong-Tie Co., Inc.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line; Eaton, Electrical Sector.
 - 2) Hilti, Inc.
 - 3) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA 101
 3. NECA 102.
 4. NECA 105.
 5. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps MSS SP-58, Type 19, complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetallic conduits, tubing, and fittings.
3. Termination boxes.
4. Metal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
3. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.
4. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product:

B. Sustainable Design Submittals:

1. Product Data: For solvents and adhesives, indicating VOC content.
2. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Allied Tube & Conduit; a part of Atkore International.
 2. Anamet Electrical, Inc.
 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
 4. Republic Conduit.
 5. Southwire Company.
 6. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040-inch, minimum
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

- K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Condux International, Inc
 - 3. Thomas & Betts Corporation; A Member of the ABB Group:
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application:
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated:
- D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material:
- E. Solvents and Adhesives: As recommended by conduit manufacturer:
 - 1. VOC Content: 510 g/L or less for PVC conduit and fittings.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Legrand, a Wiremold company.
 - 2. B-line, an Eaton business.
 - 3. Hoffman; a brand of Pentair Equipment Protection.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70:
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crouse-Hinds, an Eaton business.
 - 2. Hoffman; a brand of Pentair Equipment Protection
 - 3. Hubbell Incorporated.

4. Hubbell Incorporated; Wiring Device-Kellems.
 5. O-Z/Gedney; a brand of Emerson Industrial Automation.
 6. RACO; Hubbell.
 7. Thomas & Betts Corporation; A Member of the ABB Group.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A:
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover
- E. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application
- F. Nonmetallic Floor Boxes: Nonadjustable, rectangular:
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1:
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover:
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box:
- L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- M. Gangable boxes are allowed.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC, IMC, or RNC, Type EPC-40-PVC.
2. Concealed Conduit, Aboveground: GRC, IMC, EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT:
3. Exposed and Subject to Severe Physical Damage: EMT. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical mezzanine.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab:
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction:
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC or IMC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure

- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Surface Raceways.
 - 1. Install surface raceway with a minimum 2-inch radius control at bendpoints.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points.
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
 - 1. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
 - 3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
 - S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC in damp or wet locations not subject to severe physical damage.
 - T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
 - U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
 - V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - W. Locate boxes so that cover or plate will not span different building finishes.
 - X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
 - Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - Z. Set metal floor boxes level and flush with finished floor surface.
 - AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling".
- 3.4 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.
- 3.5 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
 - 2. Rigid nonmetallic duct.
 - 3. Flexible nonmetallic duct.
 - 4. Duct accessories.
 - 5. Precast concrete handholes.
 - 6. Polymer concrete handholes and boxes with polymer concrete cover.
 - 7. Fiberglass handholes and boxes with polymer concrete cover.
 - 8. Fiberglass handholes and boxes.
 - 9. High-density plastic boxes.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.3 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.
- D. GRC: Galvanized rigid steel conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including spacers and miscellaneous components.
 - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Include accessories for manholes, handholes, boxes and other utility structures.
 - 4. Include underground-line warning tape.
 - 5. Include warning planks.
- B. Shop Drawings:
 - 1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design and manhole chimneys.
 - e. Include ladder details.
 - f. Include grounding details.
 - g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - h. Include joint details.
 - 2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include cover design.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For duct and duct bank. Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.
- B. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.
- C. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C858.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, insulators and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.
- D. Comply with local codes and guidelines.

1.8 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Underground Plastic Utilities Duct: Type DB-60 PVC and Type DB-120 PVC RNC, complying with NEMA TC 6 & 8 and ASTM F512 for direct burial, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.

- C. Underground Plastic Utilities Duct: Type EB-20 PVC RNC, complying with NEMA TC 6 & 8, ASTM F512, and UL 651, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- D. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
 - 1. <Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Allied Tube & Conduit; Atkore International.
 - c. Cantex Inc.
 - d. IPEX USA LLC.
 - e. PenCell Plastics.
 - f. Underground Devices, Inc.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
- C. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
 - 1. Color: Red dye added to concrete during batching.
 - 2. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch-deep letters.

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Christy Concrete Products.
 - 2. Elmhurst-Chicago Stone Co.
 - 3. Oldcastle Infrastructure Inc.; CRH Americas.
 - 4. Rinker Group, Ltd.
 - 5. Riverton Concrete Products.
 - 6. Utility Concrete Products, LLC.
 - 7. Utility Vault Co.
 - 8. Wausau Tile Inc.
- C. Comply with ASTM C858 for design and manufacturing processes.

- D. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 - E. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - F. Cover Legend: Molded lettering, "ELECTRIC."
 - G. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
 - H. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - 1. Extension shall provide increased depth of 12 inches.
 - 2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
 - I. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
 - J. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - 1. Splayed location.
 - 2. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
 - 4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - 5. Knockout panels shall be 1-1/2 to 2 inches thick.
 - K. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - 1. Type and size shall match fittings to duct to be terminated.
 - 2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
 - L. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- 2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER
- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - B. <Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armorcast Products Company.
 - 2. MacLean Highline.
 - 3. NewBasis.

4. Oldcastle Infrastructure Inc.; CRH Americas.
 5. Quazite; Hubbell Incorporated, Power Systems.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Green.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.6 FIBERGLASS HANDHOLES AND BOXES

- A. Description: Molded of fiberglass-reinforced polyester resin, with covers made of polymer concrete.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Christy Concrete Products.
 2. MacLean Highline.
 3. Nordic Fiberglass, Inc.
 4. Oldcastle Infrastructure Inc.; CRH Americas.
 5. Quazite; Hubbell Incorporated, Power Systems.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Green.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

- H. Cover Legend: Molded lettering, "ELECTRIC."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.7 HIGH-DENSITY PLASTIC BOXES

- A. Description: Injection molded of HDPE or copolymer-polypropylene. Cover shall be made of plastic.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Nordic Fiberglass, Inc.
 - 2. Oldcastle Infrastructure Inc.; CRH Americas.
 - 3. PenCell Plastics.
 - 4. Quazite; Hubbell Incorporated, Power Systems.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Green.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.8 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C1037.

- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Cables More Than 600 V: Type EPC-80-PVC, Type EPC-40-PVC or Type EB-20-PVC RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC or Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- C. Duct for Electrical Branch Circuits: Type EPC-80-PVC or Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- D. Underground Ducts Crossing Paved Paths, Walks, Driveways, Roadways and Railroads: Type EPC-40 PVC RNC, encased in reinforced concrete.
- E. Stub-ups: Concrete-encased RNC or GRC.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, structural load rating.

2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20] [Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

B. Manholes: Precast or cast-in-place concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete as required by the Owner.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
 1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.

- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell, without reducing duct slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to terminator spacing 10 feet from the terminator, without reducing duct line slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch.
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- K. Pulling Cord: Install 200-lbf- test nylon cord in empty ducts.
- L. Concrete-Encased Ducts and Duct Bank:
 - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
 - 2. Width: Excavate trench 12 inches wider than duct on each side.
 - 3. Depth: Install so top of duct envelope is at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
 - 4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - 5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet duct. Place spacers within 24 inches of duct

- ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.
 7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
 8. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 10. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
 11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
 12. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

M. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 12 inches wider than duct on each side.
3. Width: Excavate trench 3 inches wider than duct on each side.
4. Depth: Install top of duct at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
8. Install duct with a minimum of 3 inches between ducts for like services and 6 inches between power and communications duct.

9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
 - a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.
 - b. Place minimum 6 inches of engineered fill above concrete encasement of duct.
- N. Warning Planks: Bury warning planks approximately 12 inches above direct-buried duct, placing them 24 inches o.c. Align planks along the width and along the centerline of duct or duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.
- O. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches above all concrete-encased duct and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

- A. Cast-in-Place Manhole Installation:
1. Finish interior surfaces with a smooth-troweled finish.
 2. Knockouts for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
 3. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.
- B. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C891 unless otherwise indicated.
 2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
 2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
 3. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 4. Where indicated, cast handhole cover frame integrally with handhole structure.

- D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
 - 1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 - 2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.
- F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 071353 "Elastomeric Sheet Waterproofing." After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- G. Damp proofing: Apply damp proofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Damp proofing materials and installation are specified in Section 071113 "Bituminous Damp proofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
- H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators as required for installation and support of cables and conductors and as indicated.
- I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below frost line below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

- F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep.

3.8 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
 - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
 - 1. Sweep floor, removing dirt and debris.
 - 2. Remove foreign material.

END OF SECTION 260543

SECTION 260544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
3. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.
 - b. CCI Piping Systems.
 - c. Flexicraft Industries.
 - d. GPT; an EnPro Industries company.
2. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Wall Sleeves, Cast Iron:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Ductile Iron Pipe.
 - b. Flexicraft Industries.
 - c. McWane Ductile.
2. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Pipe Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CCI Piping Systems.
 - b. GPT; an EnPro Industries company.
 - c. Metraflex Company (The).
2. Description: ASTM D1785, Schedule 40.

D. Molded Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Arlington Industries, Inc.
 - c. Reliance Worldwide Corporation.
2. Description: With nailing flange for attaching to wooden forms.

E. Molded Sleeves, PE or PP:

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. Crete-Sleeve.
2. Description: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sheet Metal Sleeves, Galvanized Steel, Round:

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. Benefast.
 - b. Specified Technologies, Inc.
2. Description: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abesco Fire LLC.
 - b. Specified Technologies, Inc.
 - c. Wiremold; Legrand North America, LLC.
2. Description:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch (400 mm), thickness must be 0.052 inch.
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inch, thickness must be 0.138 inch.

2.3 SLEEVE SEAL SYSTEMS

- ### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. BWM Company.
 3. Flexicraft Industries.
 4. Metraflex Company (The).
 5. Pipeline Seal and Insulator, Inc.
- ### B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
1. Sealing Elements: EPDM Nitrile rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

- ### 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. W.R. Meadows, Inc.
- ### B. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.5 FOAM SEALANTS

- 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. Dow Chemical Company (The).
 2. Innovative Chemical Products (Building Solutions Group).
- B. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor, so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed or seismic criteria require different clearance.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- E. Underground, Exterior-Wall and Floor Penetrations:
 - 1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
 - 2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Labels.
 - 2. Bands and tubes.
 - 3. Tapes and stencils.
 - 4. Tags.
 - 5. Signs.
 - 6. Cable ties.
 - 7. Miscellaneous identification products.

- B. Related Requirements:

- 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 260573 "Overcurrent Protective Device Coordination Study" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Color for Neutral: White (208/120V system).
 - 4. Color for Equipment Grounds: Green.
 - 5. Colors for Isolated Grounds: Green with two or more yellow stripes.
 - 6. Color for 0-10V: Pink and purple.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.

- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
- F. Equipment Identification Labels:
 - 1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 2. Marker for Labels:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - 3. Tape Type I:
 - a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Thickness: 4 mils.
 - d. Weight: 18.5 lb/1000 sq. ft.
 - e. Tensile according to ASTM D882: 30 lbf and 2500 psi.
 - 4. Tape Type II:
 - a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Thickness: 12 mils.
 - d. Weight: 36.1 lb/1000 sq. ft.
 - e. Tensile according to ASTM D882: 400 lbf and 11,500 psi.
 - 5. Tape Type ID:
 - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 5 mils.
 - d. Foil Core Thickness: 0.35 mil

- e. Weight: 28 lb/1000 sq. ft.
 - f. Tensile according to ASTM D882: 70 lbf and 4600 psi.
6. Tape Type IID:
- a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 8 mils.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 34 lb/1000 sq. ft..
 - f. Tensile according to ASTM D882: 300 lbf and 12,500 psi.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
- C. Write-on Tags:
 - 1. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
 - 2. Marker for Tags:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.7 SIGNS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 10 by 14 inches.
- C. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:

- a. For signs up to 20 sq. in., minimum 1/16 inch thick.
- b. For signs larger than 20 sq. in., 1/8 inch thick.
- c. Engraved legend with black letters on white face.
- d. Self-adhesive.
- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 ps.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- M. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- W. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- X. Metal Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using general-purpose cable ties.
- Y. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using general-purpose cable ties.
- Z. Write-on Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using general-purpose cable ties.
- AA. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals.
- D. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 60 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 1. "EMERGENCY POWER."
 2. "POWER."
 3. "UPS."

- F. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- H. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- I. Conductors to Be Extended in the Future: Attach marker tape to conductors.
- J. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- K. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- L. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- M. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- N. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- O. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- P. Arc Flash Warning Labeling: Self-adhesive labels.
- Q. Operating Instruction Signs: Self-adhesive labels.

- R. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- S. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Stenciled legend 4 inches high.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Emergency system boxes and enclosures.
 - e. Enclosed switches.
 - f. Enclosed circuit breakers.
 - g. Enclosed controllers.
 - h. Variable-speed controllers.
 - i. Push-button stations.
 - j. Power-transfer equipment.
 - k. Contactors.
 - l. Remote-controlled switches, dimmer modules, and control devices.
 - m. Battery-inverter units.
 - n. Battery racks.
 - o. Power-generating units.
 - p. Monitoring and control equipment.
 - q. UPS equipment.

END OF SECTION 260553

SECTION 260573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study performed by a licensed professional engineer hired by the electrical contractor.
- B. Section includes computer-based arc flash hazard analysis study. Recommendations for reducing Arc Flash Incident Energy levels and enhancing worker safety shall be issued based on the results of the study.
- C. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. AFIE - Arc Flash Incident Energy.

1.3 SUBMITTALS.

- A. The complete fault current, arc flash and coordination study is required to be submitted seven (7) calendar days prior to the submittal of any switchgear, panelboards, overcurrent devices, motor control devices, UPS and transfer switches.
- B. Product Data: For computer software program to be used for studies.
- C. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399, for arc flash study - compliance with IEEE 1584.
- D. Qualification Data: For coordination-study specialist. Submit names and references for at least five actual Arc-Flash Hazard Analysis performed in the past year.
- E. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports
 - 3. Coordination-Study Report
 - 4. Arc Flash Study Report

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study and Arc Flash Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state of Pennsylvania, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 241 and 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.
- E. Comply with IEEE 1584-2002 for arc flash calculations procedures.
- F. Comply with the National Electrical Code
- G. Comply with National Electrical Code Article 110.

1.5 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 2. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - 3. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- B. American National Standards Institute (ANSI):
 - 1. C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - 2. ANSI Z535.4 – Identification of AFIE and appropriate Personal Protective Equipment Classes

PART 2 - PRODUCTS.

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following software developers.
 - 1. SKM Systems Analysis, Inc.
 - 2. CGI CYME.
 - 3. EDSA Micro Corporation.
 - 4. ESA Inc.
 - 5. Operation Technology, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS.

- A. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- B. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features.
 - a. Arcing faults.
 - b. Simultaneous faults.

PART 3 - EXECUTION.

3.1 EXAMINATION.

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. All new and existing devices and circuit breakers associated with the project shall be fully coordinated.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled.
 - 2. Proceed with arc flash analysis only after relevant equipment submittals have been assembled.
 - 3. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.
 - 4. Contractor shall set all of the new and existing device values as recommended by the coordination study results.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical

3.3 FAULT-CURRENT STUDY.

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Switchgear and switchboard bus.
 2. Motor-control center.
 3. Distribution panelboard.
 4. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
 1. Transformers:
 - a. IEEE C57.96.
 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 3. Low-Voltage Fuses: IEEE C37.46.
- E. Study-Report.
 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY.

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study.

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists

between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information.

- a. Device tag.
 - b. Voltage and current ratio curves.
 - c. Three phase and single phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- F. Prepare and include in study completed data sheets for setting of overcurrent protective devices

3.5 ARC FLASH HAZARD ANALYSIS.

- A. Perform Arc-Flash Hazard Analysis with the aid of computer software intended for this purpose in order to calculate AFIE levels and flash protection boundary distances.
- B. Perform Arc-Flash Hazard Analysis in conjunction with a short-circuit analysis and a time-current coordination analysis.
- C. Submit the results of the Analysis in tabular form, and include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
- D. Perform the analysis under worst-case Arc-Flash conditions, and describe in the final report when applicable, how these conditions differ from worst-case bolted fault conditions.
- E. Provide equipment labels in compliance with ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes.

END OF SECTION 260573

SECTION 260800 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY.

- A. The purpose of this section is to specify the Division 26 responsibilities and participation in the commissioning process.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
- C. Work under this contract shall conform to requirements of Division 01, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers commissioning of electrical systems which are part of this project.
- D. Commissioning work shall be a team effort to ensure that all electrical equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance. Commissioning shall coordinate system documentation, equipment start-up, and verification and performance testing.
- E. The Commissioning Authority shall have responsibility for coordinating and directing each step of the commissioning process. The Authority shall be a true third party, not affiliated with any of the companies involved with the project design.
- F. Electrical system installation, start-up, testing, preparation of O&M manuals, and operator training are the responsibility of the Division 26 Contractors, with coordination, observation, verification and commissioning the responsibility of Division 01, Section 01 9113. The 01 9113 commissioning process does not relieve Division 26 from the obligations to complete all portions of work in a satisfactory and fully operational manner.
- G. Refer to Division 01, Section 01 9113, for a full list of commissioning related definitions. A few critical definitions are included below:
 - 1. *Commissioning*. A systematic process that provides documented confirmation that specific and interconnected fire and life safety systems function according to the intended design criteria set forth in the project documents and satisfy the Owners's operational needs, including compliance requirements of any applicable laws, regulations, codes, and standards requiring fire and life safety systems.
 - 2. *Commissioning Authority (CxA)*. The qualified person, company, or agency that plans, coordinates, and oversees the entire Cx process.
 - 3. *Commissioning Plan*. The document prepared for each project which identifies the processes and procedures necessary for a successful Cx process.
 - 4. *Commissioning Record*. The complete set of commissioning documentation for the project, which is turned over to the Owner at the end of the construction phase.
 - 5. *Functional Testing*. Tests performed to verify compliance with manufacturers' specifications, applicable codes and standards, and the project BOD and OPR

1.2 RELATED SECTIONS

- A. Division 01 Section 01 9113 - General Commissioning Requirements.
- B. Division 22 Section 22 0800 - Commissioning of Plumbing Systems.
- C. Division 23 Section 23 0800 - Commissioning of HVAC Systems.
- D. Division 25 Section 25 0800 - Commissioning of Integrated Automation.
- E. Individual Division 01, 21, 22, 23, 25, and 26 sections contain requirements related to the commissioning process.

1.3 ROLES AND RESPONSIBILITIES.

- A. Refer to Section 01 9113 for Commissioning Authority, Owner, Architect, and General Contractor roles and responsibilities.
- B. Refer to Section 22 0800 for plumbing contractor roles and responsibilities.
- C. Refer to Section 23 0800 for HVAC contractor roles and responsibilities.
- D. Refer to Section 25 0800 for integrated automation contractor roles and responsibilities.
- E. Electrical Contractor:
 - 1. Include cost to complete commissioning requirements for electrical systems in the contract price.
 - 2. Include requirements for submittal data, O&M data, and training in each purchase order or subcontract written.
 - 3. Ensure cooperation and participation of specialty subcontractors such as communications, data, etc.
 - 4. Ensure participation of major equipment manufacturers in appropriate training and testing activities.
 - 5. Attend Construction Phase coordination meeting scheduled by the Commissioning Authority.
 - 6. Conduct electrical system orientation and inspection when equipment is set.
 - 7. Respond to (in writing) and address items documented in the Contractor Commissioning Issues Log.
 - 8. Submit copies of all test results to the CxA
 - 9. Complete Pre-Functional Checklists for all equipment.
 - a. If no other system is agreed upon by Commissioning Team, Mechanical Contractor shall be responsible for completion of Pre-Functional Checklists for all equipment for which it issued a purchase order.
 - b. Mechanical Contractor shall coordinate completion of Pre-Functional Checklists with all other contractors that have made connections to equipment for which it issued a purchase order.
 - c. Remedy any deficiencies identified in Pre-Functional Checklists and notify CxA in writing that deficiencies have been addressed.
 - 10. Assist the Commissioning Authority in all Pre-Functional Checklist verifications and Functional Performance Tests.

11. Prepare preliminary schedule for electrical system orientation and inspections, O&M manual submission, training sessions, emergency generator testing, equipment start up, and task completion for use by the Commissioning Authority. Update schedule as appropriate throughout the construction period.
12. Attend initial training session.
13. Conduct electrical system orientation and inspection at the equipment placement completion stage.
14. Update drawings to the record condition to date, and review with the Commissioning Authority.
15. Gather O&M data on all equipment and assemble in binders as required by the Commissioning Specification. Submit to Commissioning Authority for review prior to the completion of construction.
16. Notify the Commissioning Authority a minimum of two weeks in advance, so that witnessing equipment and system start-up and testing can begin.
17. Participate in, and schedule vendors and Contractors to participate in the training sessions as set up by the Commissioning Authority
18. Provide a complete set of as-built records to the Commissioning Authority

F. Equipment Suppliers and Miscellaneous Contractors:

1. Include cost for commissioning requirements in the contract price.
2. Provide submittals, and appropriate O&M manual section(s).
3. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
4. Participate in training sessions as scheduled by the Commissioning Authority.
5. Demonstrate performance of equipment as applicable.

1.4 SCOPE OF WORK

A. Commissioning work of Division 26 shall include, but not be limited to:

1. Testing and start-up of the equipment.
2. Completion of Functional Checklists.
3. Cooperation with the Commissioning Authority.
4. Providing qualified personnel for participation in commissioning tests, including seasonal testing required after the initial testing
5. Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
6. Providing operation and maintenance manuals, and as-built drawings to the Commissioning Authority for verification
7. Providing training and demonstrations for the systems specified in this Division.

B. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems, and sub-systems. The following equipment and systems shall be evaluated:

1. Indoor lighting and controls including power transfer schemes, emergency lighting, and outdoor lighting.
2. Emergency power monitoring and operation.
3. Electrical support for mechanical equipment listed in Section 23 0800 - Commissioning of HVAC Systems.

- C. System components which will not be functionally performance tested but will be included in the commissioning scope for conformance to the design documents, verification of specified Contractor testing, construction phase observation, and training verification shall include:
1. Primary switchgear.
 2. Primary transformer.
 3. Main switchgear.
 4. Distribution switchgear.
 5. Distribution switchboards.
 6. Panel boards.
 7. Isolation power systems.
 8. Power conditioners.
 9. Power factor correction
- D. Timely and accurate documentation is essential for the commissioning process to be effective. Documentation required as part of the commissioning process shall include but not be limited to:
1. Commissioning Process Reports, which may include the following:
 - a. Commissioning Field Reports.
 - b. Design Team Issues Log.
 - c. Contractor Commissioning Issues Log on the WCxs.
 - d. Meeting minutes.
 2. Pre-start, and start-up procedures.
 3. Pre-functional Checklists.
 4. Functional Test Procedures.
 5. Training agenda and materials.
 6. As-built records.
 7. Commissioning report.
 8. Operation and maintenance (O&M) manuals.
 9. Mapping of reports into maintenance programs.
- E. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents. All tests shall be witnessed by the Commissioning Authority. The following testing is required as part of the commissioning process:
1. Functional Checklists are comprised of a full range of checks and tests to determine that all components, equipment, systems, and interfaces between systems operate in accordance with contract documents. Verification is completed by the Division 23, 26, and 28 contractors and documented using Functional Checklists
 2. Functional Performance Tests (FPT) shall determine if the electrical system is operating in accordance with the design intent. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.
- F. Comprehensive training of O&M personnel shall be performed by the Electrical Contractor, and where appropriate, by other sub-contractors, and vendors prior to turnover of building to the Owner. The training shall include classroom instruction, along with hands-on instruction on the installed equipment and systems.

1.5 DOCUMENTATION

- A. Commissioning Authority is Air Balancing Engineers Inc., 1175 N. Vine Street, Berwick, PA 18603. Phone (570) 759-1625.

PART 2 - PRODUCTS.

2.1 TEST EQUIPMENT.

- A. The appropriate Contractor(s) shall furnish all special tools and equipment required for testing during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Authority for approval. The Owner shall furnish necessary utilities for the commissioning process.

2.2 TEST EQUIPMENT - PROPRIETARY.

- A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

PART 3 - EXECUTION.

3.1 GENERAL

- A. A pre-construction meeting of all commissioning team members shall be held at a time and place designated by the Construction Manager. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.
- B. The Contractor shall complete all phases of work so the systems can be started, tested, balanced, and commissioning procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders:
- C. A Commissioning Plan shall be developed by the Commissioning Authority. The Contractor shall assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority shall notify the Owner.
- D. Acceptance procedures are normally intended to begin prior to completion of a system and/or sub-systems and shall be coordinated with the Division 26 contractor. Start of acceptance procedures before system completion does not relieve the contractor from completing those systems as per the schedule.

3.2 PARTICIPATION IN COMMISSIONING.

- A. The Contractor shall provide skilled technicians to start-up and debug all systems within Division 26. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Authority and coordinated by the contractor. Contractor shall ensure that the qualified technician(s) are available and present during the agreed upon

schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

- B. System performance problems and discrepancies may require additional technician time, Commissioning Authority time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained.
- C. The Commissioning Authority reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and a willingness to work with the Commissioning Authority. Contractor shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION.

- A. In some systems, maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Construction Manager, with input from the contractor, equipment supplier, and Commissioning Authority. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Construction Manager shall have final jurisdiction over any additional work done to achieve performance:
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Experimentation to demonstrate system performance may be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority shall notify the Construction Manager, indicating the nature of the problem, expected steps to be taken, and suggested deadline(s) for completion of activities. If the deadline(s) pass without resolution of the problem, the Construction Manager reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner shall be the contractor's responsibility.
- C. The Owner's contract with the Commissioning Authority includes up to two tests of each piece of equipment or system included in the commissioning scope. Commissioning Authority time and expenses required for retests beyond two, if required, due to incomplete installation or otherwise, will be paid by the Owner and reimbursed by the contractor.

3.4 ADDITIONAL COMMISSIONING.

- A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The contractor(s), suppliers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of their contractual obligations.

3.5 SEASONAL COMMISSIONING.

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

- B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

3.6 CONSTRUCTION PHASE OBSERVATION

- A. Scope of Construction Phase Observation.
 - 1. The Commissioning Authority will conduct periodic observations during the construction phase to monitor progress and compliance with the design intent and contract documents.
 - 2. Commissioning Authority observations will coincide with design team observations and are not intended to take the place of this work.
- B. Documentation and Reporting
 - 1. Issues identified by the Commissioning Authority during construction phase will be documented on the Issues Log on the WCxS and distributed to Commissioning Team members.
 - 2. Progress during the construction phase will also be documented by the Commissioning Authority using Commissioning Process Reports.

3.7 ACCEPTANCE PROCEDURES.

- A. Pre-Functional Checklists.
 - 1. Scope of Pre-Functional Checklists.
 - a. Tests and verifications included in the Pre-Functional Checklists shall determine if all components, equipment, systems, and interfaces between systems are installed and are ready to operate in accordance with contract documents.
 - 2. Participants in Pre-Functional Checklists.
 - a. The Commissioning Authority shall be responsible for preparing the scope of these checklists, which will be completed by the installing contractors and then verified (via spot checking and Functional Performance Testing). Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Following is a list of tasks and supporting information that shall be required.
 - b. HVAC Contractor - provide the services of a technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.
 - c. Controls Contractor - provide the services of a controls engineer who is familiar with the details of the project. Provide details of the control system, schematics, and a narrative description of control sequences of operation.
 - d. Electrical Contractor - provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.
 - 3. Documentation and Reporting Requirements.

- a. Pre-Functional Checklists shall be provided for each component, piece of equipment, system, and sub-system, including all interfaces, interlocks, etc. Each item to be tested shall have a different entry line with space provided for comments. The checklists will include spaces for each party to sign off on.
 - b. Completed checklists shall be submitted to the Commissioning Authority for acceptance and inclusion in the commissioning report.
 4. Acceptance of Pre-Functional Checklists.
 - a. The Commissioning Authority will select, at random, 10% of the checklists for verification, 100% of the Fire Alarm checklist.
 - b. If 10% or more of the checklists are found to be inaccurate for each system or equipment type, all of the checklists for that system or equipment type will be rejected. Complete, accurate checklists will need to be resubmitted.
- B. Functional Performance Testing.
 1. Scope of Functional Performance Testing.
 - a. Functional performance tests shall determine if the electrical system is operating in accordance with the final design intent. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.
 2. Submittals.
 - a. Detailed procedures for each series of tests will be developed by the Commissioning Authority for review and acceptance by the Construction Manager. The procedures shall include samples of the data sheets that will be part of the reports.
 3. Participants in Functional Performance Tests
 - a. Participants in the functional performance tests shall be the same as those listed in the Functional Checklists
 4. Functional Performance Test Procedures.
 - a. The Commissioning Authority shall supervise and direct all functional performance tests
 - 1) Set the system equipment into the operating mode to be tested (i.e. normal shut-down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
 - 2) The Commissioning Authority shall inspect and verify the position of each device and interlock identified in the test procedure. Each item shall be signed off as acceptable or failed.
 - 3) This test shall be repeated for each operating cycle that applies to the mechanical system being tested.
 - 4) Operating checks shall include all safety cutouts, alarms, and interlocks with smoke control and life safety systems during all modes of operation of the electrical system.
 - 5) If during a test an operating deficiency is observed, appropriate comments will be added to the web-based commissioning software.
 - b. If deficiencies are identified during Functional Performance Testing, the Construction Manager/General Contractor will be notified, and action taken to

remedy the deficiency. The final completed functional test procedures on the WCxS will be reviewed by the Commissioning Authority to determine if testing is complete and the system is functioning in accordance with the contract documents.

5. Documentation and Reporting Requirements.

- a. All measured data, data sheets, and a comprehensive summary, describing the operation of the electrical system at the time of testing shall be submitted to the Commissioning Authority.
- b. A preliminary functional performance test report shall be prepared by the Commissioning Authority and submitted to the Design Professional for review. Any identified deficiencies need to be evaluated by the Design Professional and Construction Manager/General Contractor to determine if they are part of the contractor's or sub-contractor's contractual obligations. Construction deficiencies shall be corrected by the responsible contractor(s), and the specific functional performance test repeated.
- c. If it is determined that the electrical system is constructed in accordance with the contract documents, and the performance deficiencies are not part of the contract documents, the Construction Manager must decide whether any required modifications needed to bring the performance of the electrical system up to the finalized design intent shall be implemented, or if the test shall be accepted as submitted. If corrective work is performed, the Construction Manager shall determine if a portion or all required functional performance tests should be repeated, and a revised report submitted.

3.8 SYSTEMS MANUAL

- A. The Systems Manual shall be submitted in paper AND/OR electronic format and shall contain the following major sections:

1. System Descriptions:

- a. Each major system shall be described, typewritten, in general terms, including major components, interconnections, theory of operation, theory of controls, unusual features and major safety precautions. This information should correlate with information provided in the manufacturers' instructions book. This section shall include, but not be limited to, the following data.
 - 1) Detailed description of each system and each of its components with diagrams and illustrations where applicable
 - 2) Wiring and control diagrams with data to explain detailed operation and control of each component.
 - 3) Control sequences describing start-up, all modes of operation, and shut down.
 - 4) Corrected shop drawings.
 - 5) Approved product data including all performance curves and rating data
 - 6) Copies of approved certifications and laboratory or factory test reports (where applicable).
 - 7) Copies of warranties.
- b. System diagrams, described in the following section, shall be incorporated in the appropriate systems descriptions. These should be reduced in size or folded to usefully fit into the manual.

2. Operating Instructions.

- a. Condensed, typewritten, suitable for posting, instructions shall be provided for each major piece of equipment. Where more than one (1) common unit is installed, one instruction is adequate. The instructions shall provide procedures for:
 - 1) Starting up the equipment/system.
 - 2) Shutting down the equipment/system.
 - 3) Operating the equipment in emergency or unusual conditions.
 - 4) Safety precautions
 - 5) Trouble shooting suggestions.
 - 6) Other pertinent data applicable to the operation of particular systems or equipment
- b. The instructions shall be suitable for posting adjacent to the equipment concerned.
- c. The contractor shall provide instructions for (at minimum):
 - 1) Transformers.
 - 2) Primary switchgear and substations.
 - 3) Secondary switchgear and switchboards.
 - 4) Automatic transfer switches.
 - 5) Emergency power systems.
 - 6) Lighting control systems.
 - 7) Lighting control systems.
 - 8) Fire alarm systems.
 - 9) Security systems.
 - 10) Clock systems.
 - 11) Paging systems.
 - 12) Uninterruptible power systems/inverters.
 - 13) SCADA systems.

3. Ongoing and Preventive Maintenance:

- a. Condensed, typewritten procedures for recommended ongoing and preventive maintenance actions shall be provided for each category of equipment/system listed above. This information shall include, but not be limited to the following:
 - 1) Maintenance and overhaul instructions.
 - 2) Parts list, including source of supply and recommended spare parts.
 - 3) Name, address, and 24 hour telephone number of each subcontractor who installed equipment and systems, and local representative for each type of system.
 - 4) Other pertinent data applicable to the maintenance of particular systems or equipment.
- b. These recommended preventive maintenance actions shall be categorized by the following recommended frequencies:
 - 1) Weekly.
 - 2) Monthly.
 - 3) Quarterly.
 - 4) Semi-Annual.
 - 5) Annual.
 - 6) Other.

B. Posted Operating Instructions and Diagrams:

1. Operating Instructions:

- a. Copies of operating instructions provided in the operating manual shall be posted in the near vicinity of each piece of applicable equipment. The instructions shall be mounted neatly in frames under Plexiglas, where they can be easily read by operating personnel. Instructions mounted outdoors shall be suitably protected from weather.

2. Posted-Systems Diagrams:

- a. Simplified one-line diagrams of the systems listed shall be developed using AutoCAD and posted neatly under Plexiglas in the main or most appropriate equipment room for easy reference by operating and maintenance personnel. These drawings shall be done in a professional manner which is acceptable to the Construction Manager. The diagrams shall show each component including all devices installed in the system, with name and identifying number. Explanatory notes, where needed, shall be provided.

- 1) Electrical one-line diagrams.
- 2) Other systems as applicable.
- 3) Emergency lighting.
- 4) Generators and Transfer Switches.
- 5) Grounding System.

- b. These diagrams shall be suitable for reduction in size and use in the operating manual system descriptions previously covered.

3.9 OPERATING AND MAINTENANCE TRAINING

- A. The Electrical Contractor, and appropriate sub-contractors, shall provide comprehensive operating and maintenance instruction on building systems prior to delivery. The instruction shall include classroom instruction delivered by competent instructors based upon the contents of the operating manual. Emphasis shall be placed upon overall systems diagrams and descriptions, and why systems were designed as they were. The classroom instruction shall also include detailed equipment instruction by qualified manufacturer representatives for which operating instructions are provided. The manufacturer representative training shall emphasize operating instructions, and preventive maintenance as described in the operating manual. At a minimum, the training sessions shall cover the following items:

1. Types of installed systems.
2. Theory of operation.
 - a. Design intent.
 - b. Occupied vs. unoccupied or partial occupancy.
 - c. Seasonal modes of operation.
 - d. Emergency conditions, transfers schemes, and procedures.
 - e. Other issues important to facility operation.
3. System operations.
4. Service, maintenance, diagnostics and repair.
5. Use of reports and logs.
6. Troubleshooting, investigation of malfunctions, and determining reasons for the problem

- B. Each classroom training period shall be followed by an inspection, explanation and demonstration of the system concerned by the instructors. All equipment listed in 3.07 A shall be started up and shut down, with the exception of sprinkler systems.
- C. The contractor shall be responsible for organizing, arranging, and delivering this instruction in an efficient and effective manner on a schedule agreeable to the Construction Manager.
- D. The contractor shall provide, at or before substantial completion, a proposed agenda and schedule of the above training for approval by the Commissioning Authority and the Construction Manager.

END OF SECTION 260800

SECTION 260813

TESTING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for Electrical Testing including, but not limited to:
 - 1. Testing of electrical components and systems
 - a. Insulation resistance test.
 - b. Continuity test.
 - c. Voltage test.
 - d. Phase relationship verification.
 - 2. Correction of defective components or systems.
 - 3. Retest of corrected components, systems.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 SUBMITTALS

- A. Test reports: Submit six (6) copies of all test reports to Architect/Engineer of Record (3 copies), General Contractor (1).
 - 1. Type each test report on 8-1/2" x 11" paper. Include
 - a. Project title and location.
 - b. Test performed.
 - c. Data performed.
 - d. Test equipment used.
 - e. Contractor's name, address and telephone number.
 - f. Testing firm's name, address and telephone number.
 - g. Names and titles of persons:
 - 1) Performing the test.
 - 2) Observing test.
 - h. Statement verifying each test.
 - i. Nameplate data from each motor and equipment item tested.
 - j. Test results.
 - k. Retest results after correction of defective components, systems.
 - l. Dates and time of test.

2. For each copy, assemble all test reports and bind them in a folder. Label each folder, "Electrical Test Reports" and include Project Number, title and location.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Furnish all equipment, manpower and casual labor to perform specified testing.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ensure that all electrical work is completed and ready for testing.
- B. Disconnect all devices or equipment that may be damaged by application of test voltages, voltage or reversed phase sequence or other procedures.

3.2 TESTING

- A. Conduct tests and adjust equipment to verify compliance with specified performance.

3.3 INSULATION RESISTANCE TESTS

- A. Resistance measured: line-to-ground.
- B. Perform testing on the following items.

Items Tested	Min. Acceptance Voltage Test	Resistance in Megohms
No. 2 and Larger Cables (600v)	1000v	50

3.4 CONTINUITY TESTS

- A. Test branch circuits and control circuits to determine continuity of wiring and connection.

3.5 VOLTAGE TESTS

- A. Make and record voltage tests and record at the following listed points. Conduct tests under normal load conditions.
 1. Terminals of all motors.
 2. Terminals of all equipment, i.e., UPS, refrigeration compressors, etc.

3.6 PHASE RELATIONSHIP

- A. Examine connections to equipment for proper phase relationships. Verify proper motor rotation.

3.7 CORRECTION OF DEFECTS

- A. When tests disclose any unsatisfactory workmanship or equipment furnished under this Contract, correct defects and retest. Repeat tests until satisfactory results are obtained.
- B. When any wiring or equipment is damaged by tests, repairs or replace such wiring or equipment. Test repaired items to ensure satisfactory operation.

3.8 CONTRACTOR STARTUP AND REPORTING

- A. Contractor shall prepare and submit a complete set of test reports as outlined in this section.

END OF SECTION 260813

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Photoelectric switches
2. Standalone Daylight-harvesting switching and dimming controls.
3. Indoor occupancy and vacancy sensors.
4. Outdoor motion sensors.
5. Switchbox-mounted occupancy sensors.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
3. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved:
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:

1.5 WARRANTY

- A. Refer to Division 01 60 00 Product Requirements specification for warranty registration requirements
- B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Cooper Industries, Inc.
 - 2. Emerson Inc.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Wattstopper / Legrand.
- B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 - 3. Time Delay: Fifteen-second minimum, to prevent false operation.
 - 4. Surge Protection: Metal-oxide varistor:
 - 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem- and-swivel mounting accessories as required to direct sensor to the north sky exposure.
 - 6. Failure Mode: Luminaire stays ON.
- C. Description: Solid state; one set of NO dry contacts rated for 24 V dc at 1 A, to operate connected load, complying with UL 773, and compatible with lighting control panelboard.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 3. Time Delay: Thirty-second minimum, to prevent false operation.

4. Mounting: 1/2-inch threaded male conduit.
5. Failure Mode: Luminaire stays ON.
6. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac.
 - a. LED status lights to indicate load status.
 - b. Plenum rated.
7. Power Pack: Digital controller capable of accepting three RJ45 inputs with one outputs rated for 20-A LED load at 120- and 277-V ac, for 16-A ballast or LED at 120- and 277- V ac. Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
 - a. With integral current monitoring.
 - b. Compatible with digital addressable lighting interface.
 - c. Plenum rated.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Wattstopper / Legrand Cooper Industries, Inc..
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
 5. Lighting fixture supplied integral sensors.
- B. General Requirements for Sensors:
 1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 2. Dual technology.
 3. Integrated power pack.
 4. Hardwired connection to switch and BAS; and BAS and lighting control system.
 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes
 - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes
 7. Sensor Output: Sensor is powered from the power pack.
 8. Power: Line voltage.
 9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 10. Mounting:

- a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 12. Bypass Switch: Override the "on" function in case of sensor failure.
 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on- off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Wattstopper / Legrand Cooper Industries, Inc..
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V.

2.4 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Schneider Electric Inc.
 - 2. Wattstopper / Legrand Cooper Industries, Inc.
 - 3. General Electric.
 - 4. Hubbell Building Automation, Inc.
 - 5. Leviton Manufacturing Co., Inc.
 - 6. Lutron Electronics Co., Inc.
- B. Description: Electrically operated and electrically held, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.

2.5 OUTDOOR MOTION SENSORS (PIR)

- A. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as rain-tight according to UL 773A.
 - 1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 2. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
 - b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 3. Bypass Switch: Override the on function in case of sensor failure.
 - 4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc; keep lighting off during daylight hours.
- B. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
- C. Detection Coverage: Up to 35 feet, with a field of view of 180 degrees.
- D. Retain "Interface with DDC System for HVAC" Paragraph below for interface with the DDC system for HVAC. Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC".

2.6 EMERGENCY SHUNT RELAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wattstopper / Legrand Cooper Industries, Inc.
2. General Electric.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lutron Electronics Co., Inc.

- B. Description: NC, electrically held relay, arranged for wiring in parallel with automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 V.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.
- C. Size conductors in accordance with lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems.
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and dead band controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, the service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262100

LOW VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Electrical service requirements.
- B. Related Requirements:
 - 1. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
 - 2. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 3. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
 - 4. Section 26 0526 - Grounding and Bonding for Electrical Systems.
 - 5. Section 26 0529 - Hangers and Supports for Electrical Systems.
 - 6. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
 - 7. Section 26 2416 - Panelboards.
 - 8. Section 26 2713 - Electricity Metering: Non-utility electrical metering.
 - 9. Section 26 2818 - Enclosed Switches: Service entrance equipment
 - 10. Section 31 2316 - Excavation.
 - 11. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
 - 12. Section 33 7119 - Electrical Underground Ducts and Manholes.

1.2 DEFINITIONS.

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.3 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; Institute of Electrical and Electronic Engineers; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS.

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing services.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 - 1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.5 SUBMITTALS

- A. Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.

1.6 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. IEEE C2 (National Electrical Safety Code).
 - 2. NFPA 70 (National Electrical Code).
 - 3. The requirements of the Utility Company

- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 - PRODUCTS.

2.1 ELECTRICAL SERVICE REQUIREMENTS.

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Division of Responsibility: As indicated on drawings.
- D. Division of Responsibility:
 - 1. Pad-Mounted Utility Transformers:
 - a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
 - b. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
 - c. Primary:
 - 1) Trenching and Backfilling: Provided by Contractor.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Utility Company.
 - d. Secondary:
 - 1) Trenching and Backfilling: Provided by Contractor.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Utility Company.
 - 2. Terminations at Service Point: Provided by Utility Company.

3. Metering Provisions:
 - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.

E. Products Furnished by Construction Manager: Comply with Utility Company requirements.

PART 3 - EXECUTION.

3.1 EXAMINATION.

- A. Verify that field measurements are as shown on drawings.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements:
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION.

- A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION.

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required trenching and backfilling in accordance with Section 31 2316.13.
- E. Provide required support and attachment components in accordance with Section 26 0529.
- F. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.
- G. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.4 PROTECTION.

- A. Protect installed equipment from subsequent construction operations.

END OF SECTION 262100

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Construction Manager's written permission.
 - 3. Comply with NFPA 70E.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 12 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 - 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted (as indicated on the drawings), dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Height: 84 inches maximum.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- F. Incoming Mains:
 - 1. Location: Convertible between top and bottom.
 - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 4. Isolated Ground Bus (where required and shown with isolated ground devices): Adequate for branch-circuit isolated ground conductors; insulated from box.
 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
 7. Split Bus: Vertical buses divided into individual vertical sections.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 10 percent.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Siemens Industry, Inc., Energy Management Division.
 - 2. Square D; Schneider Electric USA.
 - 3. General Electric
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or lugs only as noted on drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker: Bolt-on circuit breakers.
- F. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: As indicated on Drawings.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

- F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

- 1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

- 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and $I^2 T$ response.
- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- 8. Subfeed Circuit Breakers: Vertically mounted.
- 9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

- g. Communication Capability: Din-rail-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - k. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - l. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - m. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - n. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - o. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - p. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - q. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 2. Comply with requirements for seismic control devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

- F. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- G. Mount top of trim such that top breaker does not exceed 67 inches above finished floor.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. For recessed mounted panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - C. Acceptance Testing Preparation:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
 - D. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - E. Panelboards will be considered defective if they do not pass tests and inspections.
 - F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
 - B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."
 - C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 1. Measure loads during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262713
ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes equipment for utility company's electricity metering.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual. Include the following:
 - 1. Electricity metering equipment.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
 - 3. Mounting and anchoring devices recommended by manufacturer to resist seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".
- C. Manufacturer Seismic Qualification Certification for Electricity-Metering Equipment: Submit certification that equipment components and their mounting and anchorage provisions have been designed to remain in place without separation of any parts or loosening of factory-made connections when subjected to the seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculations.
 - 2. Detailed description of equipment mounting and anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For electricity-metering equipment to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center as specified in NECA 400.

1.5 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power and communication services.
 - 2. Coordinate installation and connection of utilities and services, including provision for electricity- metering components.

1.6 WARRANTY

- A. Receive, store, and handle modular meter center as specified in NECA 400.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Erickson Electric Equipment Company.
 - b. Milbank Manufacturing Company.
 - c. Cooper Industries.
 - d. Cutler-Hammer; Eaton Corporation.
 - e. General Electric Company; Electrical Distribution & Control Div.
 - f. Siemens Energy & Automation, Inc.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Current-Transformer Cabinets: Factory-coordinated assembly of a main service terminal box with lugs only. Comply with requirements of electrical power utility company.
 - 1. Available Manufacturers:
 - a. Cutler-Hammer; Eaton Corporation.

- b. General Electric Company; Electrical Distribution & Control Div.
 - c. Siemens Energy & Automation, Inc
 - d. Milbank.
 - e. Erickson Electrical Equipment Co.
 - f. Cooper Industries.
- 2. Housing: NEMA Type 3R enclosure.
 - a. Structural strength of the housing, its anchorage and component attachment provisions, and anchorage devices recommended for anchoring the housing in place shall be adequate to prevent separation of equipment and its components from their installed positions during a seismic event as defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".
- 3. Minimum Short-Circuit Rating: 100,000 amperes symmetrical at rated voltage.
- 4. Meter Socket: Comply with requirements of electrical power utility company. Type as approved by utility company, with rating coordinated with indicated tenant feeder circuit rating.
- 5. Provide a 3-pole fused switch (size as indicated on the drawings) on load side of utility meter within common enclosure. Provide metal barrier in accordance with power utility company requirements.
- 6. Metering equipment shall be compatible with Emerson's Building Automation System interface.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to switchboard installation requirements in NECA 400.

3.2 FIELD QUALITY CONTROL

- A. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data:
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

5. Repair or replace deficient or malfunctioning metering equipment, or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

END OF SECTION 262713

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Standard-grade receptacles, 125 V, 20 A.
 - 2. USB receptacles.
 - 3. GFCI receptacles, 125 V, 20 A.
 - 4. Twist-locking receptacles.
 - 5. Pendant cord-connector devices.
 - 6. Cord and plug sets.
 - 7. Toggle switches, 120/277 V, 20 A.
 - 8. Decorator-style devices, 20 A.
 - 9. Wall plates.
 - 10. Floor service fittings.
 - 11. Poke-through assemblies.
 - 12. Service poles.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.6 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. Service/Power Poles: One for every 10, but no fewer than one.
 - 2. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
 - 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than one.
 - 4. SPD Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with requirements in this Section.
- F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red.
3. SPD Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Leviton Manufacturing Co., Inc.
2. Pass & Seymour; Legrand North America, LLC.
3. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
4. Arrow Hart, Wiring Devices; Eaton, Electrical Sector

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

B. Isolated-Ground Duplex Receptacles, 125 V, 20 A:

1. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

D. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

E. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 USB RECEPTACLES

A. USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
2. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
3. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.5 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.6 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L5-20R, or as specified on the drawings.
2. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L6-20R, or as specified on the drawings.
2. Standards: Comply with UL 498.

C. Twist-Lock, Single Receptacles, 277 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L7-20R, or as specified on the drawings.
2. Standards: Comply with UL 498.

D. Twist-Lock, Isolated-Ground, Single Receptacles, 125 V, 20 A:

1. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
2. Configuration: NEMA WD 6, Configuration L5-20R, or as specified on the drawings.
3. Standards: Comply with UL 498.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

B. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R, or as specified on the drawings.

- C. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- D. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
- E. Standards: Comply with FS W-C-596.

2.8 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 - 1. Standards: Comply with UL 20 and FS W-S-896.
- B. Antimicrobial, Single-Pole Switches, 120/277 V, 20 A:
 - 1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
 - 2. Standards: Comply with UL 20 and FS W-S-896.
- C. Two-Pole Switches, 120/277 V, 20 A:
 - 1. Comply with UL 20 and FS W-S-896.
- D. Antimicrobial, Double-Pole Switches, 120/277 V, 20 A:
 - 1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
 - 2. Standards: Comply with UL 20 and FS W-S-896.
- E. Three-Way Switches, 120/277 V, 20 A:
 - 1. Comply with UL 20 and FS W-S-896.
- F. Antimicrobial, Three-Way Switches, 120/277 V, 20 A:
 - 1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
 - 2. Standards: Comply with UL 20 and FS W-S-896.
- G. Four-Way Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.
 - H. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:
 1. Description: Illuminated when switch is on.
 2. Standards: Comply with UL 20 and FS W-S-896.
 - I. Lighted Single-Pole Switches, 120/277 V, 20 A:
 1. Description: Handle illuminated when switch is on.
 2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 - J. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:
 1. Description: Factory-supplied key in lieu of switch handle.
 2. Standards: Comply with UL 20 and FS W-S-896.
 - K. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
 1. Description: For use with mechanically held lighting contactors.
 2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 - L. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
 1. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- 2.10 DECORATOR-STYLE DEVICES, 20 A
- A. Decorator Duplex Receptacles, 125 V, 20 A:
 1. Description: Two pole, three wire, and self-grounding. Square face.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Standards: Comply with UL 498.
 - B. Decorator Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Standards: Comply with UL 498.
 4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
 - C. Decorator, Tamper- and Weather-Resistant, Duplex Receptacles, 125 V, 20 A:
 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Standards: Comply with UL 498.

4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

D. Decorator Single-Pole Switches, 120/277 V, 20 A:

1. Comply with UL 20.

E. Decorator Single-Pole Lighted Switches, 120/277 V, 20 A:

1. Description: Square face illuminated when circuit is switched off.
2. Standards: Comply with UL 20.

F. Decorator, Antimicrobial, Single-Pole Switches, 120/277 V, 20 A:

1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Standards: Comply with UL 20 and FS W-S-896.

2.11 TIMER LIGHT SWITCH

A. Digital Timer Light Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Tork/RSI Industries
2. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 20-minute increments.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Integral relay for connection to BAS.

2.12 DIMMERS

A. Wall-Box Dimmers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
3. Control: Continuously adjustable slider; with single-pole or three-way switching.
4. Standards: Comply with UL 1472.

- a. 600 W; dimmers shall require no derating when ganged with other devices.
5. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 10 percent of full brightness.

2.13 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.
- D. Antimicrobial Cover Plates:
 1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
 2. Tarnish resistant.

2.14 FLOOR SERVICE FITTINGS

- A. Flush-Type Floor Service Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - c. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
 - d. Wiremold; Legrand North America, LLC.
 2. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
 3. Compartments: Barrier separates power from voice and data communication cabling.
 4. Service Plate and Cover: Round solid brass with satin finish.
 5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
 6. Data Communication Outlet: Blank cover with bushed cable opening.
- B. Flap-Type Service Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - c. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
 - d. Wiremold; Legrand North America, LLC.
2. Description: Type: Modular, flap-type, dual-service units suitable for wiring method used, with flaps flush with finished floor.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Flaps: **Round, solid brass** with satin finish.
5. Service Plate: Same finish as flaps.
6. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
7. Data Communication Outlet: Blank cover with bushed cable opening.

C. Above-Floor Service Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - c. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
 - d. Wiremold; Legrand North America, LLC.
2. Description: Type: Modular, above-floor, dual-service units suitable for wiring method used.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Service Plate: Round, solid brass with satin finish.
5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
6. Data Communication Outlet: Blank cover with bushed cable opening.

2.15 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pass & Seymour; Legrand North America, LLC.
 2. Square D; Schneider Electric USA.
 3. Wiremold; Legrand North America, LLC.
 4. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
- C. Standards: Comply with scrub water exclusion requirements in UL 514.
- D. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks or flush type with four simplex receptacles and space for four RJ-45 jacks as shown on

drawings, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."

- E. Size: Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.
- F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- G. Closure Plug: Arranged to close unused 4-inch (100-mm) cored openings and reestablish fire rating of floor.
- H. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Feed through GFCI receptacles are not permitted. GFCI receptacles shall not be daisy chained with non-GFCI receptacles where each location requires or is noted on the drawings with GFCI protection.
- B. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

- C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. In healthcare facilities, prepare reports that comply with NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813

FUSES

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Panelboards.
 - c. Switchboards.
 - d. Enclosed controllers.
 - e. Enclosed switches.
 - 2. Spare-fuse cabinets.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 - 5. Coordination charts and tables and related data.

6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data, include the following:
 1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
 4. Coordination charts and tables and related data.

1.4 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.5 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Bussmann; Eaton, Electrical Sector.
 2. Littelfuse, Inc.
 3. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 1. Type RK-1: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.

2. Type RK-5: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting or time delay.
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting or time delay.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
7. Type T: 250-V, zero- to 1200-A or 600-V, zero- to 800-A rating, 200 kAIC, very fast acting or time delay.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager.

3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. 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."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Products Division.
 2. Eaton.

3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty:

1. Single or Double (as noted on drawings) throw.
2. Three pole.
3. 240 or 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Provide quantity, type and rating as required by manufacturer for equipment being served.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.4 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussmann; Eaton, Electrical Sector.
 2. Littelfuse, Inc.
 3. Mersen USA.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: Ratings as shown on drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch Ratings as shown on drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- E. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power source of enough capacity to operate shunt trip, pilot, indicating and control devices.

F. Accessories:

1. Oiltight key switch for key-to-test function.
2. Isolated neutral lug; 100 percent rating.
3. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
4. Form C alarm contacts that change state when switch is tripped.
5. Three-pole, double-throw, fire-safety and alarm relay; coordinate coil voltage with vendor.
6. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
7. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
8. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
9. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
10. Auxiliary Contact Kit: Provide quantity, type and rating as required by manufacturer for equipment being served.
11. Hookstick Handle: Allows use of a hookstick to operate the handle.
12. Lugs: Mechanical type, suitable for number, size, and conductor material.
13. Service-Rated Switches: Labeled for use as service equipment.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Products Division.
 2. NOARK Electric North America.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be as indicated on the Drawings.
- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 167 deg F rated wire as a minimum.
- G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.

- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings for circuit breakers rated 200A and greater:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I-squared t response.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- O. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 7. Auxiliary Contacts: Provide quantity, type and rating as required by manufacturer for equipment being served.
 - 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - 9. Zone-Selective Interlocking: Integral with ground-fault trip unit; for interlocking ground-fault protection function.
 - 10. Electrical Operator: Provide remote control for on, off, and reset operations.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover for disconnect switches and directly operable through the front cover of the enclosure for molded case breakers. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Construction Manager's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.

3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections for Switches:
 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:

- 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuse holder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.

- a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.

- g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
 - E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
 - F. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- 3.7 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
 - B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262816

SECTION 263213.13

DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Diesel engine.
 - 2. Diesel fuel-oil system.
 - 3. Control and monitoring.
 - 4. Generator overcurrent and fault protection.
 - 5. Generator, exciter, and voltage regulator.
 - 6. Outdoor engine generator enclosure.
 - 7. Remote radiator motors.
 - 8. Vibration isolation devices.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.
 - 3. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.2 DEFINITIONS

- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Include thermal damage curve for generator.
 - 3. Include time-current characteristic curves for generator protective device.

4. Include fuel consumption in gallons per hour (at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity).
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer and testing agency.

B. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight supplied enclosure, external silencer, [subbase-mounted fuel tank, skid-mounted load bank, and each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.

7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control reports.

E. Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- b. Operating instructions laminated and mounted adjacent to generator location.
- c. Training plan.

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. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Caterpillar, Inc.; Electric Power Division.
 - 2. Generac Power Systems, Inc.
 - 3. Kohler Power Systems.
 - 4. MTU America Inc.
- B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.
- C. Basis of design is Generac Power Systems, Inc. using the sizing program. Contractor shall be responsible to provide calculations if another manufacturer is used to verify generator size with that specific manufacturer. Base calculations and loads will be provided upon request.

2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
 - 3. Comply with NFPA 99.
 - 4. Comply with NFPA 110 requirements for Level 1 EPSS.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.
- E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 41 to 104 deg F.
 - 2. Relative Humidity: Zero to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Power Rating: Standby.
- D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.
- E. EPSS Class: Engine generator shall be classified as a Class 48 according to NFPA 110.
- F. Service Load: 200kW/ 250kVA.
- G. Power Factor: 0.8, lagging.
- H. Frequency: 60 Hz.
- I. Voltage: 208/120-V ac.
- J. Phase: Three-phase, four wire, wye.
- K. Induction Method: Turbocharged.
- L. Governor: Adjustable isochronous, with speed sensing.
- M. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.
- N. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
 - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- O. Engine Generator Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time:
 - a. Comply with NFPA 110, Type 10 system requirements.

P. Engine Generator Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time:
 - a. Comply with NFPA 110, Type 10 system requirements.

Q. Parallel Engine Generators:

1. Automatic reactive output power control and load sharing between engine generators operated in parallel.
2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.

3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.

2.4 DIESEL ENGINE

- A. Fuel: ASTM D975, diesel fuel oil, Grade 2-D S15.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid-mounted.
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499 and with NFPA 110 requirements for Level 1 equipment for heater capacity.
- E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump.
 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F , and non collapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- F. Muffler/Silencer:
 1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - a. Minimum sound attenuation of 25 dB at 500 Hz.
 - b. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 72 dBA or less.

2. Semicritical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - a. Minimum sound attenuation of 18 dB at 500 Hz.
 - b. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
 3. Commercial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - a. Minimum sound attenuation of 12 dB at 500 Hz.
 - b. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 90 dBA or less.
- G. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- H. Starting System: 12V electric, with negative ground.
1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
 7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
 8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 9. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- C. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Configuration:
 - 1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
 - 2. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel. Panel shall be powered from the engine generator battery.
 - a. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.
 - b. Switchboard Construction: Freestanding unit complying with Section 262413 "Switchboards." Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
 - c. Switchgear Construction: Freestanding unit complying with Section 262300 "Low-Voltage Switchgear."
- F. Control and Monitoring Panel:
 - 1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
 - 2. Instruments: Located on the control and monitoring panel and viewable during operation.
 - a. Engine lubricating-oil pressure gage.
 - b. Engine-coolant temperature gage.

- c. DC voltmeter (alternator battery charging).
 - d. Running-time meter.
 - e. AC voltmeter, for each phase.
 - f. AC ammeter, for each phase.
 - g. AC frequency meter.
 - h. Generator-voltage adjusting rheostat.
3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:
- a. Cranking control equipment.
 - b. Run-Off-Auto switch.
 - c. Control switch not in automatic position alarm.
 - d. Overcrank alarm.
 - e. Overcrank shutdown device.
 - f. Low-water temperature alarm.
 - g. High engine temperature prealarm.
 - h. High engine temperature.
 - i. High engine temperature shutdown device.
 - j. Overspeed alarm.
 - k. Overspeed shutdown device.
 - l. Low fuel main tank.
- 1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for duration required for the indicated EPSS class.
- m. Coolant low-level alarm.
 - n. Coolant low-level shutdown device.
 - o. Coolant high-temperature prealarm.
 - p. Coolant high-temperature alarm.
 - q. Coolant low-temperature alarm.
 - r. Coolant high-temperature shutdown device.
 - s. EPS load indicator.
 - t. Battery high-voltage alarm.
 - u. Low cranking voltage alarm.
 - v. Battery-charger malfunction alarm.
 - w. Battery low-voltage alarm.
 - x. Lamp test.
 - y. Contacts for local and remote common alarm.
 - z. Low-starting air pressure alarm.
 - aa. Low-starting hydraulic pressure alarm.
 - bb. Remote manual stop shutdown device.
 - cc. Air shutdown damper alarm when used.
 - dd. Air shutdown damper shutdown device when used.
 - ee. Generator overcurrent-protective-device not-closed alarm.
 - ff. Hours of operation.
 - gg. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

G. Connection to Datalink:

- 1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
- 2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet. Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control."

- H. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
1. Overcrank alarm.
 2. Low water-temperature alarm.
 3. High engine temperature prealarm.
 4. High engine temperature alarm.
 5. Low lube oil pressure alarm.
 6. Overspeed alarm.
 7. Low fuel main tank alarm.
 8. Low coolant level alarm.
 9. Low cranking voltage alarm.
 10. Contacts for local and remote common alarm.
 11. Audible-alarm silencing switch.
 12. Air shutdown damper when used.
 13. Run-Off-Auto switch.
 14. Control switch not in automatic position alarm.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. Lamp test.
 18. Low-cranking voltage alarm.
 19. Generator overcurrent-protective-device not-closed alarm.
- I. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.
- J. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.
1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
 2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Overcurrent Protective Device:
1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:
 - a. Tripping Characteristic: Designed specifically for generator protection.
 - b. Trip Rating: Matched to generator output rating.

- c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
 - d. Mounting: Adjacent to, or integrated with, control and monitoring panel.
 - 2. Molded-case circuit breaker, electronic-trip type; 100 percent rated; complying with UL 489:
 - a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - b. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
 - d. Mounting: Adjacent to, or integrated with, control and monitoring panel.
 - 3. Insulated-case circuit breaker, electronic-trip type; 100 percent rated; complying with UL 489:
 - a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - b. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
 - d. Mounting: Adjacent to, or integrated with, control and monitoring panel.
 - 4. Molded-case type disconnect switch; 100 percent rated:
 - a. Trip Rating: Matched to generator output rating.
 - b. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
- C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
 - 2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 - 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
 - 1. Indicate ground fault with other engine generator alarm indications.
 - 2. Trip generator protective device on ground fault.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12-lead alternator.
- E. Range: Provide broad range of output voltage by adjusting the excitation level.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Enclosure: Dripproof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
 - 1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
 - 2. Maintain voltage within 30 percent on one step, full load.
 - 3. Provide anti-hunt provision to stabilize voltage.
 - 4. Maintain frequency within 15 percent and stabilize at rated frequency within 5 seconds.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description:
 - 1. Vandal-resistant, sound-attenuating, weatherproof steel housing; wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
 - a. Sound Attenuation Level: Level 2 Sound Attenuation.
 - 2. Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure; erected on concrete foundation.
- B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.

- C. Seismic Design: Comply with seismic requirements in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Hinged Doors: With padlocking provisions.
- E. Space Heater: Thermostatically controlled and sized to prevent condensation.
- F. Lighting: Provide weather-resistant LED lighting with 50 fc average maintained.
- G. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- H. Muffler Location: Within enclosure.
- I. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
 - 3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- J. Interior Lights with Switch: Factory-wired, vapor-proof luminaires within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
 - 2. DC lighting system for operation when remote source and generator are both unavailable.
- K. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

2.9 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with IEEE 115 and with NFPA 110, Level 1 Energy Converters.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Test generator, exciter, and voltage regulator as a unit.

3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Construction Manager no fewer than two working days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
 3. Install packaged engine generator having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure enclosure to anchor bolts installed in concrete bases. Concrete

base construction is specified in Section 260548.16 "Seismic Controls for Electrical Systems."

- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.
- C. Connect cooling-system water piping to engine generator and heat exchanger with flexible connectors.
- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Connect fuel piping to engines with a gate valve and union and flexible connector.
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- H. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

- A. Identify system components according to Section 260553 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency:
 - 1. Owner will engage a qualified testing agency to perform tests and inspections.
 - 2. Engage a qualified testing agency to perform tests and inspections.
 - 3. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 4. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
 - a. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate data with Drawings and the Specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect anchorage, alignment, and grounding.
 - 4) Verify that the unit is clean.
 - b. Electrical and Mechanical Tests:
 - 1) Perform insulation-resistance tests according to IEEE 43.
 - a) Machines Larger Than 200 hp: Test duration shall be 10 minutes. Calculate polarization index.
 - b) Machines 200 hp or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
 - 2) Test protective relay devices.
 - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
 - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
 - 5) Perform vibration test for each main bearing cap.
 - 6) Verify correct functioning of the governor and regulator.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.

10. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure and on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13

SECTION 263600

TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Contactor-type automatic transfer switches.
 - 2. Molded-case-type automatic transfer switches.
 - 3. Nonautomatic transfer switches.
 - 4. Transfer switch accessories.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Include material lists for each switch specified.
 - 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 - 4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer-authorized service representative.

- B. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Features and operating sequences, both automatic and manual.
 - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Member company of NETA.
 - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 - 2. Short-time withstand capability for three cycles.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Service-Rated Transfer Switch:
 - 1. Comply with UL 869A and UL 489.
 - 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
 - 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
 - 4. Provide removable link for temporary separation of the service and load grounded conductors.
 - 5. Surge Protective Device: Service rated.
 - 6. Ground-Fault Protection: Comply with UL 1008 for normal bus.
 - 7. Service Disconnecting Means: Externally operated, manual mechanically actuated.
- L. Neutral Terminal: Solid and fully rated unless otherwise indicated.

- M. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- N. Battery Charger: For generator starting batteries.
 - 1. Float type, rated 10 A.
 - 2. Ammeter to display charging current.
 - 3. Fused ac inputs and dc outputs.
- O. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- P. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 - 4. Accessible via rear access.
- Q. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Caterpillar, Inc.; Electric Power Division.
 - 2. Generac Power Systems, Inc.
 - 3. Kohler Power Systems.
 - 4. MTU America Inc.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
 - 4. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 5. Material: Hard-drawn copper, 98 percent conductivity.
 - 6. Main and Neutral Lugs: Mechanical type.
 - 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 8. Connectors shall be marked for conductor size and type according to UL 1008.

- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
 - 1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
 - 1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
 - 2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
 - 3. Fully automatic break-before-make operation with center off position.
 - 4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.
- F. Automatic Closed-Transition Transfer Switches: Connect both sources to load momentarily. Transition is controlled by programming in the automatic transfer-switch controller.
 - 1. Fully automatic make-before-break operation when transferring between two available power sources.
 - 2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
 - 3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
 - a. Initiation occurs without active control of generator.
 - b. Automatic transfer-switch controller takes active control of generator to match frequency, phase angle, and voltage.
 - c. Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
 - 4. Failure of power source serving load initiates automatic break-before-make transfer.
- G. Manual Switch Operation, Load-Breaking: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- H. Manual Switch Operation, Non-Load-Breaking: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- I. Electric Nonautomatic Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- J. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- K. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts:
 - a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.
- L. Large-Motor-Load Power Transfer:
1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.3 TRANSFER SWITCH ACCESSORIES

A. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall announce conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:
 - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 - b. Switch position.
 - c. Switch in test mode.
 - d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 - a. Indicating Lights: Grouped for each transfer switch monitored.
 - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
 - d. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
 1. For each of the tests required by UL 1008, performed on representative devices, for emergency and legally required systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.

- g. Dielectric voltage-withstand; before and after short-circuit test.
- h. Overload.
- i. Contact opening.
- j. Endurance.
- k. Short circuit.
- l. Short-time current capability.
- m. Receptacle withstand capability.
- n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 - 4. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, motor controls, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."
- G. Connect twisted pair cable according to Section 271513 "Communications Copper Horizontal Cabling."
- H. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- I. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."
- J. Final connections to equipment shall be made with liquid tight, flexible metallic conduit no more than 18 inches (457 mm) in length.

3.3 FIELD QUALITY CONTROL

- A. Administrant for Tests and Inspections:
 - 1. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- B. Tests and Inspections:
 - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
 - k. Perform visual and mechanical inspection of surge arresters.
 - l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of draw out disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:
 - a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set all relays and timers.
 - e. Verify phase rotation, phasing, and synchronized operation.
 - f. Perform automatic transfer tests.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.

- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.
- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Interior luminaires, lamps, ballasts, LED modules, internal 90-minute emergency batteries and drivers, and related accessories.
 - 2. Luminaire support.
 - 3. Emergency lighting units.
 - 4. Illuminated exit signs.
- B. Related Requirements:
 - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.
 - 3. Section 260936 "Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
 - 4. Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.2 DEFINITIONS

- A. Average Rated Lamp Life: The period of time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- B. CCT: Correlated color temperature.
- C. CRI: Color Rendering Index.
- D. Emergency Lighting Unit: A fixture with integral emergency battery power supply and the means for controlling and charging the battery. They are also known as emergency light set. Emergency lighting units available with and without integral heads.
- E. Fixture: See "Luminaire."
- F. IES (IESNA): Illuminating Engineering Society of North America.
- G. IP: International Protection or Ingress Protection Rating.
- H. LED: Light-emitting diode.
- I. Lumen: Measured output of lamp and luminaire, or both.

- J. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SYSTEM DESCRIPTION

- A. The interior lighting system shall include all lighting fixtures, lamps or LED modules, switches, mounting, wiring, control equipment, and accessories required for complete system, whether or not they are indicated or specified, as indicated in the Drawings and as specified.
- B. The lighting fixture schedules in the Drawings indicate manufacturer, fixture design, appearance and performance desired.
- C. Verify locations of light fixtures indicated in Drawings and coordinate with other reference data and materials as required prior to installation to ensure locations will not interfere with other work. Verify space above luminaires and confirm non-interference with other equipment, such as ducts, pipes, conduit and cabling, and openings. Alert Architect and Commission Authorized Representative in writing to non-standard modifications required for compliance with the Contract Documents and for installation to coordinate with ceiling system before proceeding with the Work.
- D. Verify dimensions. Where discrepancies are found within the Contract Documents, or additional information is required, immediately contact Architect for clarifications and additional information.
- E. Coordinate installation of lighting system with other trades to prevent delays in the Work and to ensure the lighting fixtures and supports will not be damaged by subsequent construction operations.
- F. Lighting fixtures indicated as "EM" or specified with an emergency ballast/driver shall be provided with a UL approved integral / internal 90-minute emergency battery complete with test station and pilot indicator light. These lighting fixtures shall be controlled with normal lighting fixtures. In the event of a power outage or branch circuit failure, emergency lights shall turn on at 100% brightness via internal battery.
- G. Lighting fixtures indicated as "EM" or specified with an emergency ballast/driver shall be provided with a remote test switch mounted to the underside of ceiling adjacent to fixture unless otherwise specified Owner's Representative.
- H. Lighting fixtures indicated as "EM" or specified with an emergency ballast/driver shall be rated for a temperature of at least negative thirty degrees Celsius (-30°C) or provided with a heater to ensure battery will not freeze.

1.4 ACTION SUBMITTALS

- A. General: Provide separate submittal product data/shop drawings for each fixture type clearly indicating the fixture type designation used in the Drawings and all pertinent options and accessories. Do not group similar fixture types together on a single cut sheet. Submittals that do not indicate option data where multiple selections exist will be returned without being reviewed.
- B. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

C. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Regulatory Requirements:
 - 1. Comply with the local authority having jurisdiction.
 - 2. Comply with EPA and municipal regulations for proper recycling or disposal of existing lamps and ballasts removed from the Site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect luminaires, lamps, and accessories during transit, delivery, storage, and handling to prevent damage.
- B. Deliver luminaires to the Site factory-assembled and wired to the greatest extent possible and in accordance with approved submittals.
- C. Store luminaires, lamps, and accessories in accordance with manufacturer's instructions in a clean, dry location, protected from weather and away from dust generating construction activities. As required, cover materials with tarpaulin or polyethylene sheeting in a manner that allows air circulation and prevents condensation beneath the covering.
- D. Keep handling on site to a minimum. Exercise particular care to avoid damage to exposed finishes and materials.

1.10 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate installation of lighting fixtures indicated to extend in continuous, wall to wall installation. Provide field, or established, dimensions to luminaire manufacturer in sufficient time so not to cause delays in the Work.
- C. Coordinate installation of lighting fixtures to allow for the recommended "burn-in" periods for the lamps installed.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
 - 1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
 - 2. Luminaires and lamps shall be labeled vibration and shock resistant.
 - 3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."
- B. Ambient Temperature: 5 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

2.2 MANUFACTURERS

- A. Manufacturers – Luminaires: Subject to compliance with requirements indicated and the design criteria specified in the Fixture Schedule. Basis of design is Current/HLI Solutions, Inc. Acceptable alternate manufactures are Acuity and Cooper Lighting.
- B. Manufacturers – Accessories: Subject to compliance with requirements.
- C. Lighting fixtures shall be one of the following three specification schedules.
- D. Specification Schedule 1
 1. Refer to drawings.
- E. Specification Schedule 2
 1. See below schedule

LIGHT FIXTURE SCHEDULE		
TYPE	MANUFACTURE	CAT NO
A	LITHONIA	2BLT2-33L-EZ1-LP835
AF	LITHONIA	2BLT2-33L-EZ1-LP836-FK22
B	LITHONIA	2BLT4-40L-EZ1-LP835
BE	LITHONIA	2BLT4-40L-EZ1-LP836-EL14L
BF	LITHONIA	2BLT4-40L-EZ1-LP837-FK24
C	LITHONIA	2BLT4-48L-EZ1-LP836
CE	LITHONIA	2BLT4-48L-EZ1-LP836-EL14L
CF	LITHONIA	2BLT4-48L-EZ1-LP837-FK24
D	KURTZON	VL-RZCD-1x4-2LEDR-835-UNV
DE	KURTZON	VL-RZCD-1x4-2LEDR-835-UNV-EM10
E	LITHONIA	LDN6-25/20-L07-MVOLT-GZ1
E1	LITHONIA	LDN6-25/20-L20-MVOLT-GZ2
E2	LITHONIA	LBRB-AL03-30LM-MWD-MVOLT-UGZ1
F	BARBICAN	16-87-24D-12H-UNV-35K-1550LM
G	BARBICAN	25-01-4W-4H-48L-UNV-WCF-3500K-1760LM
H	CAMMAN	P2440-24LN-35K-CLV-MV-WM
H1	CAMMAN	P2440-26LN-35K-CLV-MV-WM
J	SAL S3310 SERIES	S3310-L24-35K
K	WAST LED	WST LED-P1-40K-VW-MVOLT
L	LITHONIA	CXL-L48-4000LM-SEF-RDL-WD-MVOLT-GZ10-35K-80CRI
LE	LITHONIA	CXL-L48-4000LM-SEF-RDL-WD-MVOLT-GZ10-35K-80CRI-E10WLCP
EM	EXITRONIX	NXFE615WHG2
EX	EXITRONIX	QXSU
EXM	EXITRONIX	VEX-WPC1RW
RH	EXITRONIX	MIST16V5W
RHE	EXITRONIX	MIST16V5W

F. Specification Schedule 3

1. See below schedule

LIGHT FIXTURE SCHEDULE		
TYPE	MANUFACTURE	CAT NO
A	METALUX	22CZ2-29-UNV-L835-HCD
AF	METALUX	22CZ2-29-UNV-L835-HCD-FK22
B	METALUX	24CZ2-35-UNV-L835-HCD
BE	METALUX	24CZ2-35-UNV-L835-HCD-EL14W
BF	METALUX	24CZ2-35-UNV-L835-HCD-FK24
C	METALUX	24CZ2-50UNV-L835-HCD
CE	METALUX	24CZ2-50UNV-L835-HCD-EL14W
CF	METALUX	24CZ2-50UNV-L835-HCD-FK24
D	FAILSAFE	FMR-D24-4-LD4-STD-35-UNV
DE	FAILSAFE	FMR-D24-4-LD4-STD-35-UNV-EL10W
E	HALO	HC607D010-HM60525835-61WDW
E1	HALO	HC620D010-HM60525835-61WDW
E2	HALO	HC820D010-HM80525835-61WDW
F	SHAPER	143-24-P1S0-L5-835-UNV
G	SHAPER	141-48-92S-L9/835-UNV
H	NAL	HALO-P-SM-35K-WH-DIM
H1	NAL	HALO-P-MD-35K-WH-DIM
J	TECH	700WSDUE-15-B-LED927-277
K	VISIONARE	PGAS-1-T2-16LC-5-4K-UNV-WM-BK-PC-120
L	METALUX	4SNX-41SL-LW-UNV-L835-HCD-1
LE	METALUX	4SNX-41SL-LW-UNV-L835-HCD-1
EM	MULE LIGHTING	ELW-BB-7L2
EX	SUR-LITES	APX6-RG
EXM	SUR-LITES	LPXC-25
RH	SUR-LITES	SRP-50-D
RHE	SUR-LITES	SRP-50-D

2.3 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.

- b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. Solid State Lighting Luminaires: Comply with UL 8750.
 - 1. Luminous flux, luminaire efficiency and chromaticity shall be tested, measured and reported in accordance with the most current versions of IES documents LM-79 and LM-80.
 - 2. Chromaticity ranges for "white light" products, with various correlated color temperatures, shall be provided in accordance with ANSI/NEMA-C78.377.
 - 3. Drivers and power supplies shall be provided in accordance with the requirements of ANSI/NEMA-C82.SSL1 and their maximum allowable harmonic emission limits shall be in accordance with ANSI/NEMA-C82.77.
 - 4. Shall be provided with a U.S. Department of Energy (DOE) "Lighting Facts" label indicating their specific performance characteristics, tested and reported in accordance with the requirements of the most current version of IES LM-79.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Luminaire Coatings and Finishes:
 - 1. Luminaire surfaces, components, trim, and housing shall be factory pre-treated, rustproof, primed and otherwise prepared to inhibit rust and corrosion. Exposed luminaire surfaces shall be factory pre-treated, primed and finish coated with a suitable rust and corrosion inhibiting product.
 - 2. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - a. White Surfaces: 85 percent.
 - b. Specular Surfaces: 83 percent.
 - c. Diffusing Specular Surfaces: 75 percent.
 - d. Laminated Silver Metallized Film: 90 percent.
 - 3. Luminaries shall receive manufacturer's standard finish, unless otherwise indicated. Color shall be as indicated or, if not indicated, as selected by Architect from manufacturer's standard range.
 - 4. Exposed finish shall be free of streaks, runs, holidays, stains, blisters, and similar defects.
- I. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

- b. UV stabilized.
 - 2. Glass globes, diffusers and lenses shall be fabricated from annealed crystal glass, or tempered glass, unless otherwise indicated.
- J. Louvers:
 - 1. Provide louvers or baffles fabricated from aluminum reflector sheet free of marks including mars and indentations caused by fabrication and assembly techniques. No rivets, springs, or other hardware shall be visible after installation. Plastic louvers are not permitted.
 - 2. Provide non-iridescent type louvers for fixtures using fluorescent lamps.
 - 3. Provide louvers and baffles of first-quality polished, buffed, and anodized. Anodized finish shall be Alzak.
- K. Reflectors and Trims:
 - 1. Attach non-permanently affixed reflectors to housing by means of safety chains or spring clips, to prevent reflectors from falling. No part of the clip or chain shall be visible after installation, when viewed from any angle up to 45 degrees from horizontal.
 - 2. Aluminum Reflectors:
 - a. Provide reflectors and reflecting cones fabricated from aluminum reflector sheet free of marks including spinning lines, mars, and indentations caused by fabrication and assembly techniques. No rivets, springs, or other hardware shall be visible after installation. Provide only reflectors free from blemishes, scratches, or indentations.
 - b. Provide reflectors of first-quality polished, buffed, and anodized. Anodized finish shall be Alzak.
 - c. Provide non-iridescent type louvers for fixtures using fluorescent lamps.
 - d. Provide polished self-flanged trim cones, color finish shall match that of the cone.
 - 3. Painted Reflectors: Completely formed before application of primer and paint. Minimum of 87 percent reflectance white.
- L. Product Description: Provide complete luminaire assemblies with features, options and accessories as scheduled and required for complete assembly, whether specified or not.
- M. Provide fixtures constructed, wired, and installed in compliance with appropriate UL standards and applicable codes. Provide fixtures that are listed by UL for the applications and locations where they are shown. Provide all products with UL label.
- N. Verify and provide luminaires that are appropriate for the mounting conditions and space structure.
- O. All fixture components must operate within the temperature limits of their design.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.7 LED DRIVERS

- A. LED drivers shall be factory provided by the respective luminaire manufacturers, and shall be suitable for their intended use, to operate the designated LED modules listed in the Luminaire Schedule, and as specified herein, to their full light output.
- B. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR Part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- C. Provide identical drivers within each luminaire type.
- D. Provide UL listed and labeled drivers. Provide drivers with temperature ratings appropriate to the installation.
- E. Provide complete connection to LED type luminaires through both integrally installed and remote electronic drivers.

- F. Drivers shall be totally enclosed within a metallic enclosure and shall be provided with integral leads color coded per ANSI C82.11, or with poke-in style wire retaining connectors.
- G. Fixtures intended to be dimmed shall have dimming driver compatible with the specified dimmer controls.
- H. Remote Drivers:
 - 1. Remote drivers are specifically not shown on the drawings. Contractor shall install remote drivers in a readily accessible, dry, indoor, concealed location, in accordance with the manufacturer's instructions.
 - 2. Provide ventilated metal enclosures for remote drivers furnished as loose equipment. All wiring to/from remote drivers and their associated LED luminaires shall be installed in conduit.
 - 3. Verify and comply with remote distance limitations specified by the luminaire/driver manufacturer.

2.8 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with driver/ballast.
 - 1. Emergency Connection: Operate two lamp(s) continuously at an output of the rated lumens each lamp upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 - c. Humidity: More than 95 percent (condensing).

- d. Altitude: Exceeding 3300 feet.
- 4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- 5. Battery: Sealed, maintenance-free.
- 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- 7. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

2.9 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Operating at nominal voltage to be connected to either 120 or 277 volt systems.
 - 2. Lamps for AC Operation:
 - a. LEDs; 50,000 hours minimum rated lamp life.
 - 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
- C. Self-Luminous Signs:
 - 1. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 10 years.
 - 2. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

2.10 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
 - 1. Emergency Luminaires: As indicated on Fixture Schedule and Drawings, with the following additional features:
 - a. Operating at nominal voltage of 120 or 277 volt.
 - b. Internal emergency power unit.

- c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
- C. Emergency Lighting Unit:
 - 1. Emergency Lighting Unit: As indicated on Fixture Schedule and Drawings.
 - 2. Operating at nominal voltage of 120 or 277 volt.
 - 3. Wall with universal junction box adaptor.
 - 4. UV stable thermoplastic housing rated for damp locations.
 - 5. Two LED lamp heads.
 - 6. Internal emergency power unit.
- D. Remote Emergency Lighting Units:
 - 1. Emergency Lighting Unit: As indicated on Fixture Schedule and Drawings.
 - 2. Operating at nominal voltage of as indicated on Fixture Schedule and Drawings.
 - 3. Wall with universal junction box adaptor.
 - 4. UV stable thermoplastic housing rated for damp or wet locations.
 - 5. Two LED lamp heads.
 - 6. External emergency power unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.
 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
1. Attached to structural members in walls.
 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
1. Ceiling Mount:
 - a. Two 5/32-inch-diameter aircraft cable supports adjustable to 10 feet (3 m) in length.
 - b. Hook mount.
 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- I. Air- Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- J. Adjust aimable lighting fixtures as required to provide required light intensities.
- K. Adjust aimable heads of emergency lighting units as required to provide required light intensities along egress paths.
- L. Connections:
1. Connect wiring according to Division 26 Section "Conductors and Cables for Electrical Systems."
 2. Grounding lighting units. Tighten electrical connectors and terminals, including grounding connections, according to their manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

M. Lenses, Louvers and Reflectors:

1. Exercise particular care when installing fixtures and lamps in fixtures with specular reflector material to prevent smudging or damaging the reflector surface. Wear clean gloves as recommended by the fixture manufacturer.
2. Do not install removable reflectors, louvers, diffusers, and decorative elements of lighting fixtures until completion of wet work, plastering, painting and general cleanup in the area of the fixtures, but not more than three days before date scheduled for inspections that establish date of Preliminary Acceptance / Substantial Completion.
3. Parabolic luminaires shall be installed with protective covers, UL-listed for temporary lighting, over louvers. Upon completion of the Work, remove protective covers with clean gloves as recommended by fixture manufacturer.

N. Accessibility: Install equipment such as junction and pull boxes, fixture housings, transformers, ballasts, switches and controls, and other apparatus that requires occasional maintenance to be accessible and appropriate for mounting and ceiling conditions.

O. Install fixtures in mechanical areas after ductwork and piping installation. Locate and mount fixtures as indicated on Drawings unless mechanical equipment prohibits or makes it impractical to do so. In such cases, chain or wall mount fixtures so that serviceable equipment is illuminated.

P. Locate recessed ceiling luminaires as indicated on Drawings. Mount fixtures at heights and locations indicated. Where heights are not indicated or conflicts exist, coordinate final locations with Architect.

Q. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation. Replace or repair malfunctioning fixtures and components.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal. Replace or repair malfunctioning fixtures and components. Note and record the following:
 - a. Duration of supply
 - b. Low battery voltage shutdown.
 - c. Normal transfer to battery source and retransfer to normal.
 - d. Low supply voltage transfer.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265600
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY.

- A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Exterior luminaires and their associated LED modules, drivers and accessories.
 - 2. Poles, luminaire support structures and their associated accessories.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 230501 "Basic Electrical Requirements" for additional Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. ANSI: American National Standards Institute.
- B. Average Rated LED Module Life: The period of time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- C. CCT: Correlated color temperature.
- D. CRI: Color-rendering index.
- E. IES: Illuminating Engineering Society of North America.
- F. Fixture: A complete lighting unit. Fixtures include LED modules and parts required to distribute the light, position and protect LED modules, and connect them to the power supply.
- G. Luminaire: A complete lighting assembly or product consisting of not less than a light source(s) and related devices to position the light source(s), housing or enclosure, light source control and optics and light source power supply control device(s).
- H. Pole: Luminaire support structure, including tower used for large area illumination
- I. Solid State Lighting/Luminaires: Light sources and their associated luminaires that produce light (radiant energy) without the use of electrical filaments, excited gas or plasma, such as LED, OLED, or PLED.
- J. UL: Underwriter's Laboratories, Inc.

1.3 SYSTEM DESCRIPTION

- A. The exterior lighting system shall include all lighting fixtures, LED modules, switches, mounting, wiring, control equipment, and accessories, whether or not they are indicated or specified, required for a complete system, as indicated in the Drawings and as specified.
- B. The lighting fixture schedules in the Drawings indicate manufacturer, fixture design, appearance and performance desired.
- C. Verify locations of light fixtures indicated in Drawings and coordinate with other reference data and materials as required prior to installation to ensure locations will not interfere with underground utilities or openings. Alert Architect and Commission Authorized Representative in writing to non-standard modifications required for compliance with the Contract Documents prior to proceeding with the Work:
- D. Where discrepancies are found within the Contract Documents, or additional information is required, immediately contact Architect for clarifications and additional information.
- E. Coordinate installation of lighting system with other trades to prevent delays in the Work and to ensure the lighting fixtures and supports will not be damaged by subsequent construction operations.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. General: Provide separate submittal product data/shop drawings for each fixture type clearly indicating the fixture type designation used in the Drawings and all pertinent options and accessories. Do not group similar fixture types together on a single cut sheet. Submittals that do not indicate option data where multiple selections exist will be returned without being reviewed.
 - 2. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Provide separate submittal product data/shop drawings for each fixture type clearly indicating the fixture type designation used in the Drawings and all pertinent options and accessories. Do not group similar fixture types together on a single cut sheet. Submittals that do not indicate option selection where multiple selections exist will be returned without review. Include data on features, accessories, finishes, and the following:
 - a. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - b. Details of attaching luminaires and accessories.
 - c. Details of installation and construction.
 - d. Luminaire materials such as finish and color information.
 - e. Photoelectric relays.
 - f. LED Drivers: Include information as to input watts. Indicate mounting distance limitation and standard wire sizes for remote drivers.
 - g. LED modules, per luminaire tag, including life, output, and energy-efficiency data.
 - h. Materials, dimensions, accessories and finishes of poles.
 - i. Photometric data based on laboratory tests of each luminaire type, complete with indicated LED modules, drivers, and accessories.
 - j. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 - k. Pole and support structure anchor bolt information.

- I. Manufactured pole foundations, if any.
- 3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include details that cannot be adequately represented to the satisfaction of the Architect in Product Data.
 - b. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 - c. Wiring Diagrams: For power, signal, and control wiring
 - d. Photometric data certified by the manufacturer in accordance with the recommended practices of the IES.
 - e. Quantity and type of LED modules
- B. Informational Submittals:
 - 1. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a State of Maryland Registered Structural Engineer
 - 2. Warranty: Sample of special warranty.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals. Include manufacturers' recommended maintenance practices for each fixture type including, but not limited to, the following:
 - a. Tools Required.
 - b. Acceptable cleaners and recommended cleaning practices.
 - c. Replacement parts list.
 - d. Manufacturer service department contact information/Qualified Service Agencies.
 - e. Submittal data.
 - f. Operation data.
 - g. Intended operation narrative.
 - 2. Record Drawings: Submit record drawings of the actual installation within thirty (30) days of date of Preliminary Acceptance / Substantial Completion.
 - 3. Re-Commissioning Data: Submit manual containing all information required for re-commissioning of the installations.
 - a. Submit two (2) copies of manual within thirty (30) days of date of Preliminary Acceptance/Substantial Completion.
 - b. Submit re-commissioning manuals in heavy-duty, 3-ring binders. Submit manuals in accordance with Division 01 Section "Operations and Maintenance Data".

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled by a testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
- B. Solid Stat Lighting/Luminaires:

1. Luminous flux, luminaire efficiency and chromaticity shall be tested, measured and reported in accordance with the most current versions of IES documents LM-79 and LM-80.
 2. Chromaticity ranges for "white light" products, with various correlated color temperatures, shall be provided in accordance with ANSI/NEMA-C78.377.
 3. Drivers and power supplies shall be provided in accordance with the requirements of ANSI/NEMA-C82.SSL1, and their maximum allowable harmonic emission limits shall be in accordance with ANSI/NEMA-C82.77.
 4. Shall be provided with a U.S. Department of Energy (DOE) "Lighting Facts" label indicating their specific performance characteristics, tested and reported in accordance with the requirements of the most current version of IES LM-79.
- C. Commissioning: When required for the Project, Contractor shall assign representative(s) with expertise and authority to act on its behalf. The representative(s) shall perform commissioning activities including, but not limited to, the following:
1. Review submittals relative to exterior lighting systems being commissioned.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660:
- B. Store poles on decay-resistant-treated skids at least 12-inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4-inch deep. Do not apply tools to section of pole to be installed below ground line
- D. Retain factory-applied pole wrappings on metal poles until right before pole installation.
- E. Deliver exterior lighting fixtures individually wrapped in factory-fabricated fiber Commission type containers or equivalent.
- F. Handle exterior lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures; replace and return damaged units to equipment manufacturer.
- G. Store lighting fixtures in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather and construction traffic.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with manufacturer's original protective covering for storage and identified with labels describing contents. Provide a manifest of all extra materials provided.
 1. LED Modules: 1 for every 10 of each type and rating installed. Furnish at least one of each type.
 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 1 for every 10 of each type and rating installed. Furnish at least one of each type.
 3. Drivers: 1 for every 10 of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 WARRANTY

- A. Special Warranty: Submit a written warranty, beginning from date of Preliminary Acceptance / Substantial Completion, and executed by the Contractor, manufacturer, and Installer agreeing to repair or replace products or components that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within the specified warranty period. Damage due to lightning, hail, vandalism, abuse, or unauthorized repairs or alterations shall be excluded from special warranty coverage. Warranty shall include all materials and components.
1. Warranty Period for LED Luminaires: Five (5) years from date of Preliminary Acceptance / Substantial Completion.
 2. Warranty Period for Metal Corrosion: Five (5) years from date of Preliminary Acceptance / Substantial Completion.
 3. Warranty Period for Color Retention: Five (5) years from date of Preliminary Acceptance / Substantial Completion.
 4. Warranty Period for LED Modules and Fuses: Two (2) years from date of Preliminary Acceptance/Submittal Completion.
 - a. Replace LED modules and fuses that fail within 12 months from date of Preliminary Acceptance / Substantial Completion.
 - b. Furnish replacement LED modules and fuses that fail within the second 12 months from date of Preliminary Acceptance / Substantial Completion.
 5. Warranty Period for Ballasts and Drivers: Five (5) years from date of Preliminary Acceptance / Substantial Completion.
 6. Warranty Period for Poles: Three (3) years from date of Preliminary Acceptance / Substantial Completion. Warranty shall include pole finish.
 7. Warranty Period for LED Drivers: Five (5) years from date of Preliminary Acceptance / Substantial Completion.

PART 2 - PRODUCTS.

2.1 MANUFACTURERS

- A. Manufacturers – Luminaires: Subject to compliance with requirements indicated and the design criteria specified in the Fixture Schedule. Basis of design is Current/HLI Solutions, Inc. Acceptable alternate manufactures are Acuity and Cooper Lighting.

2.2 LUMINARIES

- A. Luminaries shall comply with UL 1598 and be designed, manufactured, listed, and labeled for installation in wet locations and for outdoor service. Make components, including nuts, bolts, rivets, springs, and similar parts, of corrosion resistant materials. Fixtures that are aimed upward shall be listed and labeled for installation in wet locations in that position.
- B. Provide anodized aluminum for aluminum parts of exterior fixtures that are not specified as requiring a painted finish.
- C. Lateral Light Distribution Patterns: Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect driver when door opens.
- H. Exposed Hardware Material: Stainless steel
- I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- J. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- L. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- M. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials:
 - 1. Where luminaire products are not indicated to be field painted and are not indicated to match the finish process and color of pole or support materials, provide the following.
 - a. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1) Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2) Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- N. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place:
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USES ONLY" and include specific lamp type.

b. CCT and CRI for all luminaires.

- O. Emergency Power: Provide emergency LED power pack with back box matching housing finish where indicated or, if not indicated, where required by Architect, Engineer, or Commission Authorized Representative:

2.3 LED DRIVERS

- A. LED drivers shall be factory provided by the respective luminaire manufacturers, and shall be suitable for their intended use, to operate the designated LED modules listed in the Luminaire Schedule, and as specified herein, to their full light output.
- B. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- C. Provide complete connection to LED-type luminaires through both integrally installed and remote electronic drivers.
- D. Shall be totally enclosed within a metallic enclosure and shall be provided with integral leads color coded per ANSI C82.11, or with poke-in style wire retaining connectors.
- E. Provide identical drivers within each luminaire type.
- F. Provide UL listed and labeled drivers. Provide drivers with temperature ratings appropriate to the installation.
- G. Fixtures intended to be dimmed shall have dimming driver compatible with the specified dimmer controls.
- H. Remote Drivers.
1. Remove drivers are specifically not indicated in Drawings. Install remove drivers in a readily accessible, dry, indoor, concealed location in accordance with the manufacturer's written instructions.
 2. Provide ventilated metal enclosures for remove drivers furnished as loose equipment. All wiring related to remove drivers and the related LED luminaires shall be installed in conduit.
 3. Verify and comply with the remote distance limitations specified by the luminaire/driver manufacturer.

2.4 SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- D. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36 and hot-dip galvanized according to ASTM A 123; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- E. Poles shall be provided with handhole, anchor bolt covers, and grounding lug.

2.5 EXTERIOR LIGHTING DEVICES

- A. Lighting fixtures are scheduled in Drawings. Reference the Drawings for the specified and approved fixtures.

PART 3 - EXECUTION.

3.1 EXAMINATION.

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

3.2 LUMINAIRE INSTALLATION.

- A. LED Modules: Install LED modules in each luminaire in accordance with manufacturer's instructions.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials approved in writing by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.
- D. Where fixtures are wall-mounted and protrude from the wall surface, provide additional structural support within the wall framing to accommodate the extra moment force created by the fixture.

3.3 INSTALLATION OF INDIVIDUAL GROUND MOUNTED LUMINAIRES.

- A. Install on concrete base with top 4-inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete".

3.4 CORROSION PREVENTION.

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems".
 - 1. Install a minimum of a 3/4-inch diameter by 8-foot copper grounding electrode for each pole, unless otherwise indicated, and installed as indicated in Drawings.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 RACEWAYS AND BOXES

- A. Plastic conduit shall be used where indicated in Drawings, in unpaved areas and lawn areas. The conduit shall be Schedule 40, UL Listed, polyvinyl chloride conduit, and not less than ~~1-1/2~~ 1 inch in diameter.
- B. Galvanized rigid conduit shall be used under buildings, within five feet of entrances to buildings, in pole foundations, under paved areas and walkways, and within 18-inches, horizontally, of exterior junction boxes. Rigid PVC schedule 40 conduit shall be provided on all underground raceway.
- C. Provide pull line in empty conduit and duct.
- D. Comply with the additional requirements of Division 26 Section "Raceways and Boxes for Electrical Systems".

3.7 IDENTIFICATION

- A. Provide vinyl tagging with panel source and circuit number on wiring at handhole in each pole and at each exterior box.
- B. Identify each exterior box with 1-1/2 inch high black letters and numbers on yellow weatherproof, pressure-sensitive adhesive vinyl on the covers. Labels shall be Brady #1530.
- C. Identify each pole with 3-1/2 inch high black letters and numbers on yellow weatherproof, pressure sensitive adhesive vinyl placed 78-inches above grade facing the parking areas or facing the road if the pole is at the road. Labels shall be Brady #1550.
- D. Comply with the additional requirements of Division 26 Section "Identification for Electrical Systems".

3.8 CLEANING

- A. Clean fixtures internally and externally after completion of installation. Use methods and materials recommended by manufacturer.

3.9 CONTRACTOR STARTUP AND REPORTING

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- C. Replace fixtures that show evidence of corrosion during project warranty period.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with requirements.
- E. Contractor shall train the Commission's designated maintenance personnel on the proper operation and maintenance of all products prior to Final Completion.

3.10 COMMISSIONING AND DEMONSTRATION

- A. After system checkout and adjustment, the contractor shall operate the system for the review of Architect and Commission Authorized Representative and shall make all adjustments and modifications as required by Architect and Commission Authorized Representative.

END OF SECTION 265600

SECTION 270500

COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY.

- A. Provide and install a complete structured cabling, security and background music/overhead paging system support system. The support system shall include, but not be limited to, cabling pathways, grounding and bonding systems and appropriate mounting hardware and accessories. Build out of the telecommunications room and telecommunication enclosure shall be included in the scope of the project. The telecommunication equipment racks will be furnished and installed within the scope of this project. Installation shall include setting or mounting the equipment racks in place, completion of grounding and bonding systems to properly ground and bond all equipment, members and items within the equipment racks and to connect the pre-mounted power strips within the equipment racks to the electrical receptacles. Power strip cables and all ground and bonding conductors shall be properly dressed and supported within the equipment racks and to the appropriate cable pathways. All support systems shall be installed to meet the industry standards of the cabling and connectivity being supported in addition to local and national codes.

1.3 REFERENCED STANDARDS AND CODES

- A. NFPA 70 National Electric Code (NEC).
- B. Authority Having Jurisdiction.
- C. UL® for wiring: UL® Standard 910 "Test method for fire and smoke characteristics of cable used in air handling spaces." Provide products that are UL® listed and labeled for such use. UL® testing bulletin. Underwriters Laboratories (UL®) cable certification and follow up program.
- D. American National Standards Institute/Telecommunications Industry Association. ANSI/TIA, including associated Addenda:
 - 1. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises.
 - 2. ANSI/TIA-568-C.0-1 – Generic Telecommunications Cabling for Customer Premises – Addendum 1, Updated References for Balanced Twisted-Pair.
 - 3. ANSI/TIA-568-C.0-2 – Generic Telecommunications Cabling for Customer Premises – Addendum 2, General Updates.
 - 4. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard.
 - 5. ANSI/TIA-568-C.1-1 – Commercial Building Telecommunications Cabling Standard – Addendum 1, Pathways and Spaces.
 - 6. ANSI/TIA-568-C.1-2 – Commercial Building Telecommunications Cabling Standard – Addendum 2, General Updates.

7. ANSI/TIA-568-C.2 –Balanced Twisted Pair Telecommunications Cabling and Components Standard.
 8. ANSI/TIA-568-C.3 –Optical Fiber Cabling Components Standard.
 9. ANSI/TIA-568-C.3-1 – Optical Fiber Cabling Components Standard – Addendum 1, Addition of OM4 Cabled Optical Fiber and Array Connectivity.
 10. ANSI/TIA-569-C – Telecommunications Pathways and Spaces.
 11. TIA-590-A – Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant.
 12. ANSI/TIA-606-AB – Administration Standard for Commercial Telecommunications Infrastructure
 13. ANSI/TIA-606-A-1 – Administration of Equipment Rooms and Data Center Computer Rooms.
 14. ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 15. ANSI/TIA-607-B-1 – Generic Telecommunications Bonding and grounding (Earthing) for Customer Premises Addendum 1 – External Grounding.
 16. ANSI/TIA-758-B – Customer Owned Outside Plant Telecommunications Infrastructure Standard.
 17. ANSI/TIA-1005-A – Telecommunications Infrastructure Standard for Industrial Premises.
 18. TIA TSB-155-A – Guidelines for the Assessment and Mitigation of Installed Category 6A Cabling to Support 10GBase-T.
 19. TIA TSB-184 – Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling.
 20. TIA-TSB-190 – Guidelines on Shared Pathways and Shared Sheaths.
- E. ANSI/NECA/BICSI 568-2006 – Installing Commercial Building Telecommunications Cabling.
- F. NECA/BICSI 607-2011 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.
- G. National Electrical Manufacturers Association (NEMA).
- H. Institute of Electrical and Electronic Engineers (IEEE).
- I. American Society for Testing Materials (ASTM).

1.4 RELATED SECTIONS

- A. 260526 – Grounding and Bonding for Electrical Systems.
- B. 20529 – Hangers and Supports for Electrical Systems.
- C. 270526 – Grounding and Bonding for Communications Systems.
- D. 270528 – Pathways for Communications Systems.
- E. 270544 – Sleeves and Sleeve Seals for Communications Systems

1.5 DEFINITIONS / ACRONYMS / ABBREVIATIONS

- A. AHJ – Authority Having Jurisdiction.
- B. ANSI – American National Standards Institute.

- C. AWG – American Wire Gauge.
- D. CAT 6 A – Category 6A performance as defined by ANSI/TIA 568-C.2.
- E. EC – Electrical Contractor.
- F. EIA – Electronic Industries Alliance.
- G. ER – Equipment Room.
- H. EOR – Engineer of Record.
- I. GC – General Contractor.
- J. IEC – International Electrotechnical Commission.
- K. ISO – International Organization for Standardization.
- L. MM – Multimode (Fiber Optic Cable).
- M. NECA – National Electrical Contractors Association.
- N. NEMA – National Electrical Manufacturers Association.
- O. OM4 - Optical Multimode 4 “laser optimized” performance as defined by ISO/IEC 11801 Amd2 and ANSI/TIA-568-C.3-1.
- P. OS1 - Optical Single mode 1 performance as defined by ISO/IEC 11801 and ANSI/TIA-568 C.3.
- Q. OS2 - Optical Single mode 2 “low water peak” performance as defined by ISO/IEC 11801 Amd2 and ANSI/TIA-568-C.3.
- R. SCS – Structured Cabling System.
- S. SM – Single mode (Fiber Optic Cable).
- T. STP – Shielded Twisted Pair Cable.
- U. UTP – Unshielded Twisted Pair Cable.
- V. TBB – Telecommunications Bonding Backbone.
- W. TBBIBC – Telecommunications Bonding Backbone Interconnection Bonding Conductor.
- X. TC – Telecommunications Contractor.
- Y. TIA – Telecommunications Industry Association.
- Z. TGB – Telecommunications Ground Bus Bar.
- AA. TGB – Telecommunications Main Ground Bus Bar.
- BB. TO – Telecommunications Outlet.
- CC. TR – Telecommunications Room.

DD. UNO – Unless Noted Otherwise.

1.6 SUBMITTALS.

A. Product Data:

1. Submit the following in accordance with the general conditions and Division 01 and Division 20 specifications of contract. Submittals to include index with description, specification reference, manufacturer, part number, quantity and page number for manufacturer product specification sheet. Manufacturer's product specifications sheets shall indicate product part number. Where multiple products are indicated, products being submitted shall be clearly indicated on a single specification sheet. Products requiring submittals shall include but not be limited to the following.
 - a. All cable and wire including patch cables and cross-connect wire.
 - b. All connectors and required tools.
 - c. All termination system components for each cable type.
 - d. All equipment room and telecommunications room equipment racks, cabinets, horizontal and vertical cable management, ladder tray, installation hardware and other support equipment.
 - e. All grounding system components.
 - f. All fire seal systems, including manufacturer published installation requirements
 - g. All cable raceways and support hardware

B. Samples.

1. Contractor shall provide samples to the Architect EOR for review and approval. Samples shall be provided for the following:
 - a. Each configuration of work are.
 - b. Termination hardware labeling.
 - c. Backbone labeling scheme.
 - d. Horizontal cabling labeling scheme.

C. Test Plans:

1. Contractor shall provide detailed test plans and test documentation as specified for each sub-system.

D. Shop Drawings:

1. Electrical Contractor shall produce, provide and coordinate shop drawings for all conduits, cable trays and other equipment. All shop drawings are to be coordinated with other trades, architect and EOR.
2. Telecommunications Contractor shall produce, provide and coordinate shop drawings for all ladder racks, equipment cabinets, equipment racks and other equipment. All shop drawings shall be coordinated with other trades, architect and the EOR.
3. All shop drawings are to be produced using AutoCAD version 2004 or later.
4. Cross-connection schedule is to be produced in a matrix / schedule format using the latest version of Microsoft Excel. Include soft copy and hard copies.

E. As-Built Documentation.

1. Contractor shall provide complete as-built documentation. As-built documentation shall include AutoCAD drawings indicating all conduits, cable trays, ladder racks, equipment cabinets, equipment racks and other equipment. All TOs are to be indicated on as-built drawings including TO numbers. Cable paths for all backbone cables are to be indicated on as-built drawings.
2. Contractor shall provide complete as-built documentation. As-built documentation shall include AutoCAD drawings indicating all conduits, cable trays and other equipment.
3. Contractor shall provide 3 hard copies and 1 soft copy on CD.
4. As-built drawings are to be produced using AutoCAD version 2004 or later. The following criteria are to be used:
 - a. Floor/conduit/zone plans are to be produced at a scale of 1/8"=1'0".
 - b. TR and ER partial plans are to be produced at a scale of 1/4" = 1' 0" or 1/2" = 1' 0" as appropriate to the complexity and size of the room in being depicted.
 - c. Alignment targets (targets) are to be included in each file that references a building floor plan.
 - 1) The targets are to present a cross-hair registered to building column line intersections and labeled with the column intersection thus referenced.
 - 2) The targets shall be AutoCAD blocks with the origin at the intersection of the cross-hairs and attributes for the column information.
 - 3) The alignment targets are to reside on a separate layer created for this use.
 - 4) A minimum of two (2) such alignment targets are required for each contiguous area referenced, e.g. if two floors are shown in the same drawing, two alignment targets are required per floor
 - d. Drawing files shall be prepared using English Architectural units
 - e. No custom line-styles are to be used in the preparation of the drawing files.
5. Provide a cross connect schedule for all backbone cables installed. Schedules shall indicate all pairs of the backbone cables and all installed cross connections. Schedules are to be created in latest version Microsoft Excel or another approved format. Include soft copy and hard copies.

F. Test Equipment.

1. TC shall submit manufacturer data sheets for all test equipment to be utilized in the certification of the structured cabling system.
2. The TC shall submit current calibration certificates to EOR for all equipment to be utilized in the testing of the structured cabling system. All calibration certificates are to be issued by the test equipment manufacturer. Certificates are to be received by EOR no less than seven days prior to beginning any testing.

G. Test Data.

1. The contractor shall provide test data as specified for each sub-system.

H. Warranty.

1. Contractor shall provide an extended 5-year warranty covering all work, including but not limited to: equipment, devices and labor.

1.7 CONTRACTOR QUALIFICATIONS

- A. The TC selected for this project shall be certified by the manufacturer(s) of the products specified in this scope of work, adhere to the design engineering, installation and testing procedures and utilize the authorized manufacturer(s) components in completing this project.
- B. The TC shall be experienced in all aspects of the work required to complete this project and shall be required to demonstrate direct experience on recently installed systems of similar size and type.
- C. The TC shall own and maintain equipment and tools required for the installation and testing of Category 6A copper and optical fiber structured cabling systems. The TC shall also employ personnel who are adequately trained in the uses of required tools and equipment.
- D. TC shall submit letters of certification from the proposed system manufacturer indicating the TC is an approved installer of proposed system and has had personnel trained in the proper installation and testing procedures of said system.

1.8 SCOPE OF WORK

- A. Telecommunications Scope of Work.
 - 1. The Electrical Contractor shall carefully examine the contract documents and thoroughly become familiar with the building standards and local conditions relating to the work. Failure to do so will not relieve the contractor of the obligations of the contract.
 - 2. Provide UL® listed fireseal systems for all telecommunications cabling pathways using caulk putty, pillows or similar devices per manufacturer's instructions to maintain existing and new fire ratings. Verify rating conditions and locations prior to final bids. All open sleeves, slots or other penetrations shall be fire sealed inside after all cabling is completely installed. Fireseal methods shall be submitted by contractor and shall be subject to the approval of the owner. Contractor shall provide caps and fireseal to maintain the original cores that are not to be used and/or reused. Contractor shall verify exact quantities in the field prior to submission of bids.
 - 3. Properly ground to telecommunications equipment, including but not limited to racks, cabinets, ladder tray, riser cables, etc. in accordance with manufacturer recommendations and ANSI/TIA-607-B, NFPA 70, all applicable building codes and specification section 27 05 26.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 270500

SECTION 270528

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Metallic surface pathways.
 - 7. Nonmetallic surface pathways.
 - 8. Tele-power poles.
 - 9. Hooks.
 - 10. Boxes, enclosures, and cabinets.
 - 11. Polymer-concrete handholes and boxes for exterior underground cabling.
 - 12. Fiberglass handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Surface pathways
 - 2. Wireways and fittings.
 - 3. Tele-power poles.
 - 4. Boxes, enclosures, and cabinets.
 - 5. Underground handholes and boxes.

- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Samples: For wireways, nonmetallic wireways, surface pathways and tele-power poles and for each color and texture specified, 12 inches long.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
 - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Seismic rating for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Products Division.
 - 2. Allied Tube & Conduit; Atkore International.
 - 3. Alpha Wire.
 - 4. Southwire Company.
- C. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-D.

- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. ARC: Comply with ANSI C80.5 and UL 6A.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Set screw.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch , with overlapping sleeves protecting threaded joints.
- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.
- B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with TIA-569-D.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. General Requirements for Metal Wireways and Auxiliary Gutters:
 - 1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-D.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.

2.6 SURFACE NONMETALLIC PATHWAYS:

- A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.
- B. Finish: Texture and color selected by Architect from manufacturer's standard colors.
- C. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with TIA-569-D.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep
 5. Gangable boxes are allowed.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
1. Material: sheet metal.
 2. Type: Semi-adjustable.
 3. Shape: Rectangular.
 4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, [cast aluminum] [galvanized, cast iron] with gasketed cover.
- I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Underground Conduit: RNC, Type EPC-40-PVC.
 2. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT or RNC.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: IMC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use set-screw, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-D.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from nonmetallic conduit and fittings to GRC or IMC and fittings before rising above floor.
- M. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

W. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

X. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Z. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet o.c.
5. Provide a hook at each change in direction.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe of less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 270544

SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve seal systems.
 - 3. Sleeve seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board:
- C. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 1. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel or stainless steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers".
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless sleeve seal system is to be installed, or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 3 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve seal system.

3.2 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

- B. Install 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.

3.3 SLEEVE SEAL FITTING INSTALLATION

- A. Install sleeve seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve seal fittings.

END OF SECTION 270544

SECTION 280500

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY.

- A. It is intended this project pursue a LEED "Gold" rating. LEED criteria will be followed for the installation of building systems. This Contractor shall be responsible for the following items to ensure the Facility achieves LEED certification:
 - 1. SS Credit 8 – Light Pollution Reduction.
 - 2. EA Prerequisite 2 – Minimum Energy Performance.
 - 3. EA Credit 1 – Optimize Energy Performance.
 - 4. MR Credit 2 – Construction Waste Management.
 - 5. IEQ Credit 4.1 – Low Emitting Materials: Adhesives and Sealants.
 - 6. IEQ Credit 4.2 – Low Emitting Materials: Paints and Coatings.
 - 7. IEQ Credit 6.1 – Controllability of Systems: Lighting.
- B. Section Includes:
 - 1. This Section contains the Common communications installation requirements that shall be required of Contractors bidding and executing any part of these documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION.

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION.

- A. Comply with NECA, NFPA, and OSHA requirements.
- B. All work shall be installed in a neat, workmanlike manner in accordance with ANSI/NECA 1 – 2015.
- C. All materials and equipment provided under this contract shall be new (except where otherwise noted) and shall be listed, labeled or certified by Underwriters Laboratories, Inc.
- D. All equipment of the same type and capacity shall be by the same manufacturer.
- E. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.
- F. During construction the contractor shall at all times maintain electrical utilities of the building without interruption. Should it be necessary to interrupt any electrical service or utility, the contractor shall secure permission in writing from the Construction Manager for such interruption.

at least seven days in advance. Any interruption shall be made with minimum amount of inconvenience to the Owner and any shut-down time shall have to be on a premium time basis and such time to be included in the contractor's bid. Arrange to provide and pay for temporary power source if required by project conditions.

- G. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted items.
- H. 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.
- I. Working clearance around equipment shall not be less than that specified in the N.E.C. for all voltages specified
- J. The locations of switches, receptacles, lights, motors, etc. outlets shown are approximate. The contractor shall use good judgment in placing the preceding items to eliminate all interference with ducts, piping, etc. The contractor shall check all door swings so that light switches are not located behind doors. Relocate switches as required, with approval from the Design Professional. The Construction Manager may direct relocation of outlets before installation, up to five (5) feet from the position indicated on the Drawings, without additional cost
- K. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity. Normal maintenance shall not require the removal of protective guards from adjacent equipment. Install equipment as close as practical to the locations shown on the Drawings.
 - 1. Where the Construction Manager determines that the Contractor has installed equipment not conveniently accessible for operations and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
 - 2. "Conveniently Accessible" is defined as being capable of being reached without use of ladders, or without climbing or crawling over or under obstacles such as motors, pumps, belt guards, transformers, racks, piping, ductwork, raceways or similar.
- L. Right of Way: Give to piping systems installed at a required slope.
- M. Firestopping shall be applied to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of the assembly according to Division 07 and 09 Sections and the Owner's Commissioning Agent.
- N. Owner furnished equipment: Equipment furnished by the Owner shall be received, stored, uncrated, protected, and installed by the Contractor with all appurtenances required to place the equipment in operation, ready for use. The Contractor shall be responsible for the equipment as if he had purchased the equipment himself.

END OF SECTION 280500

SECTION 284621.11
ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Heat detectors.
7. Fire-alarm notification appliances.
8. Firefighters' two-way telephone communication service.
9. Emergency responder radio coverage system.
10. Fire-alarm graphic annunciators.
11. Fire-alarm addressable interface devices.
12. Digital alarm communicator transmitters (DACTs).
13. Fire-alarm radio transmitters.

B. Related Requirements:

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- F. NICET: National Institute for Certification in Engineering Technologies.
- G. PC: Personal computer.
- H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. When new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.5 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Graphic Annunciator panel details as required by authorities having jurisdiction.
 - 5. Detail assembly and support requirements.
 - 6. Include voltage drop calculations for notification-appliance circuits.
 - 7. Include battery-size calculations.
 - 8. Include input/output matrix.

9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 10. Include performance parameters and installation details for each detector.
 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
 13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
 - c. Locate detectors in accordance with manufacturer's written instructions.
 - d. Show air-sampling detector pipe routing.
 14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 15. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
 2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

- A. Certificates:
1. Seismic Performance Certificates: For FACU, accessories, and components, from manufacturer. Include the following information:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
- B. Field quality-control reports.
- C. Qualification Statements: For Installer.
- D. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - g. Record copy of site-specific software.
 - h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - i. Manufacturer's required maintenance related to system warranty requirements.
 - j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.
- B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On USB media.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
 5. Keys and Tools: One extra set for access to locked or tamperproofed components.

6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.
8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. Installation must be by personnel certified by NICET as fire-alarm Level III technician.
3. Obtain certification by NRTL in accordance with NFPA 72.
4. Licensed or certified by authorities having jurisdiction.

1.10 FIELD CONDITIONS

A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with ASCE/SEI 7 for installed elevation above or below grade.

1. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic design loads and unit must be fully operational after seismic event."

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description:

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.
2. General Characteristics:
 - a. Automatic sensitivity control of certain smoke detectors.
 - b. Fire-alarm signal initiation must be by one or more of the following devices and systems:
 - 1) Manual stations.
 - 2) Heat detectors.
 - 3) Smoke detectors.
 - 4) Duct smoke detectors.
 - 5) Automatic sprinkler system water flow.
 - c. Fire-alarm signal must initiate the following actions:
 - 1) Continuously operate alarm notification appliances.
 - 2) Identify alarm and specific initiating device at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
 - 3) Transmit alarm signal to remote alarm receiving station.
 - 4) Unlock electric door locks in designated egress paths.
 - 5) Release fire and smoke doors held open by magnetic door holders.
 - 6) Activate voice/alarm communication system.
 - 7) Switch HVAC equipment controls to fire-alarm mode.
 - 8) Recall elevators to primary or alternate recall floors.
 - 9) Activate elevator power shunt trip.
 - 10) Record events in system memory.
 - 11) Record events by system printer.
 - 12) Indicate device in alarm on graphic annunciator.
 - d. Supervisory signal initiation must be by one or more of the following devices and actions:
 - 1) Valve supervisory switch.
 - 2) Elevator shunt-trip supervision.
 - 3) Zones or individual devices have been disabled.
 - 4) FACU has lost communication with network.
 - e. System trouble signal initiation must be by one or more of the following devices and actions:
 - 1) Open circuits, shorts, and grounds in designated circuits.
 - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4) Loss of primary power at FACU.
 - 5) Ground or single break in internal circuits of FACU.
 - 6) Abnormal ac voltage at FACU.
 - 7) Break in standby battery circuitry.
 - 8) Failure of battery charging.
 - 9) Abnormal position of switch at FACU or annunciator.

- 10) Voice signal amplifier failure.
- 11) Hose cabinet door open.
- f. System Supervisory Signal Actions:
 - 1) Initiate notification appliances.
 - 2) Identify specific device initiating event at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
 - 3) Record event on system printer.
 - 4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
 - 5) Transmit system status to building management system.
 - 6) Display system status on graphic annunciator.
- g. System Printer:
 - 1) Printer must be listed and labeled as integral part of fire-alarm system.
- h. Device Guards (where indicated on drawings or as directed by Owner):
 - 1) Description: Welded wire mesh of size and shape for manual station, smoke detector, gong, or other device requiring protection.
 - a) Factory fabricated and furnished by device manufacturer.
 - b) Finish: Paint of color to match protected device.
- i. Document Storage Box:
 - 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
 - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
 - 3) Color: Red powder-coat epoxy finish.
 - 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
 - 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

2.2 MANUFACTURERS

- A. Fire alarm system, control panel(s), devices, etc., shall have all components of manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Honeywell International (Fire-Lite Alarms).
 - 2. Honeywell International (Silent Knight).
 - 3. Siemens Industry, Inc., Building Technologies Division.
 - 4. Edwards/ UTC Climate, Controls & Security.

2.3 FIRE-ALARM CONTROL UNIT (FACU)

- A. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- B. Performance Criteria:
 - 1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
 - 2. General Characteristics:
 - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
 - b. Include real-time clock for time annotation of events on event recorder and printer.
 - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
 - d. FACU must be listed for connection to central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
 - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
 - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
 - g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, 80 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
 - h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1) Pathway Class Designations: NFPA 72, Class B.
 - 2) Install no more than 50 addressable devices on each signaling-line circuit.
 - 3) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
 - i. Serial Interfaces:
 - 1) One dedicated RS 485 port for central-station operation using point ID DACT.
 - 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - 3) One USB or RS 232]port for PC configuration.
 - 4) One RS 232 port for air-aspirating smoke detector connection.
 - 5) One RS 232 port for voice evacuation interface.
 - j. Smoke-Alarm Verification:

- 1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
 - 2) Activate approved "alarm-verification" sequence at FACU and detector.
 - 3) Record events by system printer.
 - 4) Sound general alarm if alarm is verified.
 - 5) Cancel FACU indication and system reset if alarm is not verified.
- k. Notification-Appliance Circuit:
- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
 - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
 - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- l. Elevator Recall: Initiate by one of the following alarm-initiating devices:
- 1) Elevator lobby detectors except lobby detector on designated floor.
 - 2) Smoke detectors in elevator machine room.
 - 3) Smoke detectors in elevator hoistway.
- m. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- n. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
- 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.
- o. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- p. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
- 1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
 - 2) Programmable tone and message sequence selection.
 - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
 - 4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- q. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.
- r. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- s. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for

device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.

- t. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, must be powered by 24 V(dc) source.
- u. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- v. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- w. Batteries: Sealed lead calcium.

C. Accessories:

- 1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
- 2. Preaction System Functionality:
 - a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
 - 2. Double-action mechanism requiring two actions to initiate alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
 - 3. Station Reset: Key- or wrench-operated switch.
 - 4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
 - 5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm.
 - 6. Able to perform at up to 90 percent relative humidity at 90 deg F.
 - 7. Material: Manual stations made of Lexan polycarbonate.
 - 8. Able to be used in indoor areas.

2.5 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
 - 1. Performance Criteria:
 - a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 268.

b. General Characteristics:

- 1) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 2) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 3) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 4) Integral Visual-Indicating Light: LED type, indicating detector has operated.
- 5) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 6) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- 7) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 8) Color: White.
- 9) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 10) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
- 11) Multiple levels of detection sensitivity for each sensor.
- 12) Sensitivity levels based on time of day.

2.6 DUCT SMOKE DETECTORS

A. Description: Photoelectric-type, duct-mounted smoke detector.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.
- b. UL 268A.

2. General Characteristics:

- a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- b. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- c. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- d. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.

- e. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
- f. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
- g. Each sensor must have multiple levels of detection sensitivity.
- h. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- i. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

A. Combination-Type Heat Detectors:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 521.

b. General Characteristics:

- 1) Temperature sensors must test for and communicate sensitivity range of device.

- c. Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 5 deg F per minute unless otherwise indicated.
- d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
- e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- f. Detector must have functional humidity range of 10 to 90 percent relative humidity.
- g. Color: White.

B. Fixed-Temperature-Type Heat Detectors:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 521.

b. General Characteristics:

- 1) Actuated by temperature that exceeds fixed temperature of 190 deg F .
- 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
- 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.

- 4) Detector must have functional humidity range of 10 to 90 percent.
- 5) Color: White.

2.8 MULTICRITERIA AND MULTISENSOR FIRE DETECTORS

- A. Description: Fire-sensing detectors using multiple means of detection.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - c. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. Detector must send trouble alarm if it is incapable of compensating for existing conditions.
 - d. Test button tests sensors in detector.
 - e. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present sensitivity selected.
 - 4) Sensor range (normal, dirty, etc.).
 - f. Detector must have functional humidity range within 10 to 90 percent relative humidity.
 - g. Color: White.
 - h. Comply with UL requirements.
 - i. Sensors (Multisensor Type): Detector must be comprised of four sensing elements including smoke sensor, carbon monoxide sensor, infrared sensor, and heat sensor.
 - 1) Smoke sensor must be photoelectric type as described in "System Smoke Detectors" Article.
 - 2) Carbon monoxide sensor must be as described in "Carbon Monoxide Detectors" Article.
 - 3) Heat sensor must be as described in "Heat Detectors" Article.
 - 4) Each sensor must be separately listed in accordance with requirements for its detector type.

2.9 FIRE-ALARM NOTIFICATION APPLIANCES

- A. Fire-Alarm Audible Notification Appliances:
 1. Description: Horns, bells, or other notification devices that cannot output voice messages.
 2. Performance Criteria:
 - a. Regulatory Requirements:

- 1) NFPA 72.

b. General Characteristics:

- 1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
- 2) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
- 3) Chimes, Low-Level Output: Vibrating type, 75 dB(A-weighted) minimum rated output.
- 4) Chimes, High-Level Output: Vibrating type, 81 dB(A-weighted) minimum rated output.
- 5) Sounders, High Volume 24 V(dc).
- 6) Sounders, Low Volume 24 V(dc).
- 7) Audible notification appliances must have functional humidity range of 10 to 95 percent relative humidity.
- 8) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. (3 m) from horn, using coded signal prescribed in UL 464 test protocol.
- 9) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Voice/Tone Notification Appliances:

1. Description: Notification appliances capable of outputting voice evacuation messages.
2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1480.

b. General Characteristics:

- 1) Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
- 2) High-Range Units: Rated 2 to 15 W.
- 3) Low-Range Units: Rated 1 to 2 W.
- 4) Mounting: semi-recessed.
- 5) Matching Transformers: Tap range matched to acoustical environment of speaker location.
- 6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Fire-Alarm Visible Notification Appliances:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1971.

b. General Characteristics:

- 1) Rated Light Output:
 - a) As noted on drawings.
- 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
- 5) Flashing must be in temporal pattern, synchronized with other units.
- 6) Strobe Leads: Factory connected to screw terminals.
- 7) Mounting Faceplate: Factory finished, red.

2.10 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

A. Description: Dedicated, two-way, supervised, telephone voice communication links between FACU and remote firefighters' telephone stations. Supervised telephone lines must be connected to talk circuits by controls in control module.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Common-talk type for firefighter use only.
- b. Selective-talk type for use by firefighters and fire wardens.
- c. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously. Indicator lamp must flash if phone is disconnected from talk circuits.
- d. Addressable firefighters' phone modules to monitor and control loop of firefighter phones. Module must be capable of differentiating between normal, off-hook, and trouble conditions.
- e. Audible Pulse and Tone Generator, and High-Intensity Lamp: When remote telephone is taken off hook, it causes audible signal to sound and high-intensity lamp to flash at FACU.
- f. Selector panel controls to provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on panel front by individual LEDs.
- g. Display: Digital to indicate location of caller.
- h. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated; factory-standard red finish; with handset.
 - 1) Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Warden Phone" or "Fire Emergency Phone."
 - 2) With "break-glass" door access lock.
- i. Remote Telephone Jack Stations: Single-gang, stainless steel-plate mounted plug, engraved "Fire Warden Phone" or "Fire Emergency Phone."

2.11 FIRE-ALARM GRAPHIC ANNUNCIATORS

A. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Graphic Annunciator Panel: Mounted in aluminum frame with nonglare, minimum 3/16 inch (4.76 mm) thick, clear acrylic cover over graphic representation of facility. Detector locations must be represented by red LED lamps. Normal system operation must be indicated by lighted, green LED. Trouble and supervisory alarms must be represented by amber LED.
 - 1) Comply with UL 864.
 - 2) Operating voltage must be 24 V(dc) provided by local 24 V power supply provided with annunciator.
 - 3) Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and lamp test switch.
 - 4) Semiflush mounted in NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
 - 5) Graphic representation of facility must be CAD drawing and each detector must be represented by LED in its actual location. CAD drawing must be at 1:96 (1:100) scale or larger.
 - 6) LED representing detector must flash two times per second while detector is in alarm.
- b. Graphic Annunciator Workstation: PC-based, with fire-alarm annunciator software with historical logging, report generation, and graphic interface showing alarm points in system. PC with operating system software, digital display monitor, with wireless keyboard and mouse.

2.12 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Include address-setting means on module.
- b. Store internal identifying code for control panel use to identify module type.
- c. Listed for controlling HVAC fan motor controllers.
- d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
- e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown, etc.
 - 1) Allow control panel to switch relay contacts on command.

- 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
- f. Control Module:
 - 1) Operate notification devices.
 - 2) Operate solenoids for use in sprinkler service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:
 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.
- C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 1. Devices placed in service before other trades have completed cleanup must be replaced.
 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.

- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel in existing part of building.
 - 2. Connect new equipment to existing monitoring equipment at supervising station.
 - 3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to new points. New components must be capable of merging with existing configuration without degrading performance of either system.
- C. Equipment Floor and Wall Mounting: Install FACU on finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- D. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- E. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
 - 2. Mount manual fire-alarm box on background of contrasting color.
 - 3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.
- F. Smoke- and Heat-Detector Spacing:
 - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing must not exceed 28 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.
- G. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- H. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- I. Air-Sampling Smoke Detectors: If using multiple pipe runs, runs must be pneumatically balanced.
- J. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

- K. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within dwelling or suite, they must be connected so that operation of smoke alarm causes alarm in smoke alarms to sound.
- L. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- M. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- N. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.
- O. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.
 - 1. Exposed pathways located less than 96 inch above floor must be installed in EMT.
- B. Pathways must be installed in EMT.
- C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated HVAC duct systems.
 - 4. Magnetically held-open doors.
 - 5. Electronically locked doors and access gates.
 - 6. Alarm-initiating connection to elevator recall system and components.
 - 7. Alarm-initiating connection to activate emergency lighting control.
 - 8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 9. Supervisory connections at valve supervisory switches.
 - 10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 11. Supervisory connections at elevator shunt-trip breaker.
 - 12. Data communication circuits for connection to building management system.
 - 13. Data communication circuits for connection to mass notification system.
 - 14. Supervisory connections at fire-extinguisher locations.
 - 15. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
 - 16. Supervisory connections at fire-pump engine control panel.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:

1. Owner will engage qualified testing agency to administer and perform tests and inspections.
2. Engage qualified testing agency to administer and perform tests and inspections.
3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide video recording of training to Owner.

3.12 MAINTENANCE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.13 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11

SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees, shrubs, plants and grass to remain.
 - 2. Removing existing trees, shrubs, plants and grass.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, abandoning site utilities in place and removing site utilities.
 - 7. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and temporary erosion and sedimentation control procedures.
 - 2. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Photographs, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - EXECUTION

2.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

2.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

2.3 UTILITIES

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
- B. Excavate for and remove underground utilities indicated to be removed.

2.4 CLEARING AND GRUBBING

- A. All infield mix should be cleared of any vegetation prior to being respread.
- B. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 - 4. Use only hand methods for grubbing within tree protection zone.
 - 5. Chip removed tree branches and dispose of off-site.
- C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

2.5 TOPSOIL STRIPPING

- A. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

- B. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within tree protection zones.
 - 3. Dispose of excess topsoil as specified for waste material disposal.
 - 4. Stockpile surplus topsoil to allow for resspreading deeper topsoil.

2.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

2.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, pavements and lawns and grasses.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase and base course for asphalt paving.
 - 5. Subsurface drainage backfill for walls and trenches.
 - 6. Excavating and backfilling for utility trenches.
 - 7. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
- B. Related Sections include the following:
 - 1. Division 01 Section "Unit Prices" for authorized additional excavation provisions.
 - 2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
 - 3. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.3 UNIT PRICES

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
 - 1. 12 inches outside of concrete forms other than at footings.
 - 2. 12 inches outside of concrete forms at footings.
 - 3. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - 4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - 5. 6 inches beneath bottom of concrete slabs-on-grade.

6. 6 inches beneath pipe in trenches, and the greater of 18 inches wider than pipe or 36 inches wide.

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Construction Manager. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 2. Bulk Excavation: Excavation more than 8 feet in width and more than 15 feet in length.
 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Construction Manager. Unauthorized excavation, as well as remedial work directed by Construction Manager, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 3 cu. yds. for bulk excavation or 1 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.

2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For the following:
 1. Each type of plastic warning tape.
 2. Geotextile.
 3. Controlled low-strength material, including design mixture.
- B. Samples: 12-by-12-inch Sample of subdrainage and separation geotextile.
- C. Blasting Plan: For record purposes upon approval.
- D. Seismic Survey Report: For record purposes; from seismic survey agency.
- E. Preexcavation Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.6 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 2. Seismographic monitoring during blasting operations.

- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
 - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- C. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Construction Manager and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 4 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
 - 4. Tear Strength: 56 lbf; ASTM D 4533.
 - 5. Puncture Strength: 56 lbf; ASTM D 4833.
 - 6. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 - 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:

1. Portland Cement: ASTM C 150, Type II.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260.

- B. Produce conventional-weight, controlled low-strength material with 140-psi compressive strength when tested according to ASTM C 495.

2.4 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system, specified in Division 31 Section "Dewatering," to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
 - 1. Perform blasting without damaging adjacent structures, property, or site improvements.
 - 2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.
 - 3. Contractor is responsible for all damage caused by use of explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified

excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions. Borings have been completed and the test results are located on the Plan Drawings.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 12 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 18 inches wider than pipe or 36 inches wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

- A. Notify Construction Manager when excavations have reached required subgrade.
- B. If Construction Manager determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Construction Manager, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Construction Manager, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Construction Manager.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Construction Manager.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."
- D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- E. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.
- G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Lawn or Unpaved Areas: Plus or minus 2 inches.
 2. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.

- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

- A. Construction Manager reserves the right to stop work and have a testing agency test the placed materials to ensure conformance.
- B. If the materials do not meet the specification criteria, the contractor shall be responsible for testing costs, removing affected materials and replacing suitable materials at no cost to the owner.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Construction Manager; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 312000

SECTION 321216
ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving binder course and wearing course.

1.2 PRICE AND PAYMENT PROCEDURES

A. Section 012000 - Price and Payment Procedures

B. Asphalt Paving Binder Course:

1. Basis of Measurement: By ton.
2. Basis of Payment: Includes priming surfaces, tack coating surfaces, furnishing, placing, compacting, and testing binder course.

C. Asphalt Paving Wearing Course:

1. Basis of Measurement: By ton.
2. Basis of Payment: Includes priming surfaces, tack coating surfaces, furnishing, placing, compacting, and testing wearing course.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M17 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
2. AASHTO M29 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
3. AASHTO M140 - Standard Specification for Emulsified Asphalt.
4. AASHTO M208 - Standard Specification for Cationic Emulsified Asphalt.
5. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
6. AASHTO M320 - Standard Specification for Performance-Graded Asphalt Binder.
7. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

8. AASHTO MP1a - Standard Specification for Performance-Graded Asphalt Binder.

B. Asphalt Institute:

1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.
3. AI SP-2 - Superpave Mix Design.

C. ASTM International:

1. ASTM C1371[-2004a] - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
2. ASTM C1549[-2004] - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
3. ASTM D242 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
4. ASTM D692 - Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
5. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
6. ASTM D977 - Standard Specification for Emulsified Asphalt.
7. ASTM D1073 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
8. ASTM D1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
9. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).
10. ASTM D2397 - Standard Specification for Cationic Emulsified Asphalt.
11. ASTM D2726 - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
12. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
13. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
14. ASTM D3515 - Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
15. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
16. ASTM D3910 - Standard Practices for Design, Testing, and Construction of Slurry Seal.
17. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
18. ASTM E408[-1971(1996)e1] - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
19. ASTM E903[-1996] - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
20. ASTM E1918[-1997] - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.

21. ASTM E1980[-2001] - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit product information for asphalt and aggregate materials.
 2. Submit mix design with laboratory test results supporting design.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Mixing Plant: Conform to Borough Standards.
- B. Mixing Plant: Certified by State.
- C. Obtain materials from same source throughout.
- D. Perform Work in accordance with State (PADOT Pub. 408) and Borough standards.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum 5 years documented experience.

1.7 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.
- B. Do not place asphalt mixture between November 1 and March 1 or as approved by Owner/Engineer.
- C. Do not place asphalt mixture when ambient air or base surface temperature is less than 45 degrees F, or surface is wet or frozen.
- D. Place asphalt mixture when temperature is not more than 15 degrees F less than initial mixing temperature.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

A. Performance / Design Criteria:

1. Paving: Superpave design based on million equivalent single axle loads (ESAL) for 20-year paving design life.

B. Asphalt Materials:

1. Aggregate: 9.5mm & 19.0mm.
2. Asphalt Binder: AASHTO M320; performance grade [PG 64-22], in accordance with State and Borough standards.
3. Prime Coat: MC-70 or MC-250.
4. Tack Coat: ASTM D977; diluted emulsified asphalt type.

C. Aggregate Materials:

1. Coarse Aggregate: In accordance with State and Borough standards.
2. Fine Aggregate: In accordance with State and Borough standards.

D. Aggregate Subbase: In accordance with State and Borough standards.

2.2 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Asphalt Paving Mixtures: Designed in accordance with State and Borough standards with maximum 10% percent by weight reclaimed asphalt pavement.

C. Paving Surfaces: Minimum solar reflectance index (SRI) of **29**, calculated in accordance with ASTM E1980.

1. Reflectance: Measured in accordance with ASTM E903, ASTM E1918, or ASTM C1549.
2. Emittance: Measured in accordance with ASTM E408 or ASTM C1371.

2.3 ACCESSORIES

A. Geotextile Fabric: AASHTO M288; woven, polypropylene US Fabrics US 200 (Class 3 stabilization and separation applications) or approved equal.

- B. Sealant: ASTM D6690, Type I; hot applied type.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Submit proposed mix design of each class of mix for review prior to beginning of Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- C. Verify with Owner/Engineer that compacted subgrade, granular stabilized soil, and subbase is dry and ready to support paving and imposed loads.
 - 1. Proof roll subbase with two perpendicular passes to identify soft spots.
 - 2. Remove soft subbase and replace with compacted fill.
- D. Verify gradients and elevations of base are correct.
- E. Verify gutter drainage grilles and frames, manhole frames and are installed in correct position and elevation.

3.2 PREPARATION

- A. Prepare subbase in accordance with State and Borough standards and Section 321216.10.

3.3 DEMOLITION

- A. Saw cut and notch existing paving as indicted on Drawings.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 INSTALLATION

- A. Tack Coat:

1. Apply tack coat on asphalt and concrete surfaces over subgrade surface at uniform rate.
 - a. New Surfaces: 1/2 gal/sq. yd.
 - b. Existing Surfaces: 1/2 gal/sq. yd.
2. Apply tack coat to contact surfaces of curbs, gutters and structures.
3. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

B. Single Course Asphalt Paving:

1. Install Work in accordance with State and Borough standards.
2. Place asphalt within 24 hours of applying primer or tack coat.
3. Place asphalt wearing course to thickness indicated on Drawings.
4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Complete compaction before mix temperature cools to 185° F.
6. Perform rolling with consecutive passes to achieve even and smooth finish.

3.5 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.
- C. Scheduled Compacted Thickness: Within 1/4.
- D. Variation from Indicated Elevation: Within 1/2 inch.

3.6 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting, testing.
- B. Asphalt Paving Mix Temperature: Measure temperature at time of placement. Lay HMA only when temperature is between 250- and 350-degrees Fahrenheit.

3.7 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements.
- B. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

END OF SECTION 321216